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MARCH 13, 1959

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This is the first of a series of six insets appearing in this journal during the next twelve months. The next section will be appearing 8th May, 1959.

FLIGHT INSTRUMENTS

Kelvin Hughes Accelerometer

Developed from the large case type, this Accelerometer is for use where panel space in the aircraft is at a premium. The instrument is housed in a small S.A.E. case and weighs approximately 15oz.

Kelvin Hughes Accelerometer

Large S.A.E. case type. Magnetic damping ensures indication of both long and short period accelerations. Main pointer indicates prevailing 'g' conditions whilst the remaining two indicate maximum positive and negative 'g' until reset. Various ranges available.

Smiths Airspeed Indicator

A single pointer type with a linear scale for uniform clear presentation. Artificially aged capsules for stability. Low range versions have a single turn pointer; higher ranges, double turn. Calibrations in m.p.h., knots or Km/Hr.

Smiths Airspeed Indicator

Multi-turn sensitive type for high speed aircraft. An accurate instrument with an open scale and two pointers. The capsule is frequency damped; the movement is light but robust and is mounted in a large S.A.E. case.

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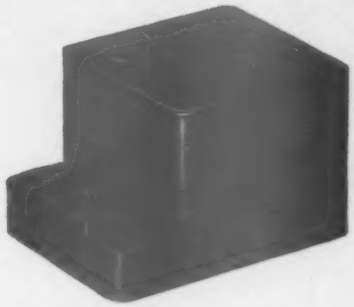

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Smiths Contents Gauge Indicators

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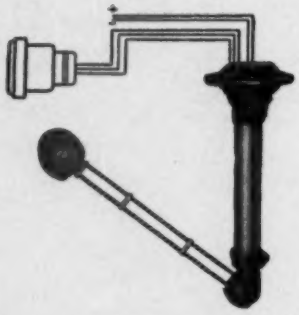
Smiths Contents Gauge Indicators

Operating on the 'Desynn' principle and used in conjunction with float arm tank units, these remote reading indicators are available as shown in the small S.A.E. case, or as multiple versions with up to four separate movements in the large S.A.E. case. Failure of the 24V d.c. power supply is immediately apparent by an off-scale movement of the pointer.



Smiths Contents Gauge Tank Unit

This is the transmitting unit of the 'Desynn' Contents Gauge. Specially designed for installation in fuel tanks, it can be fitted to the top, side or bottom of the tank according to particular requirements. Operation is from a nominal 24V d.c. supply.

Smiths Contents Gauge Tank Unit

A direct-reading type intended primarily for light aircraft, it combines the advantages of direct reading with that of remote indication. Available for mounting in the top or side of the tank, it obviates the need for an indicator in the cockpit panel and does not need an electrical supply.

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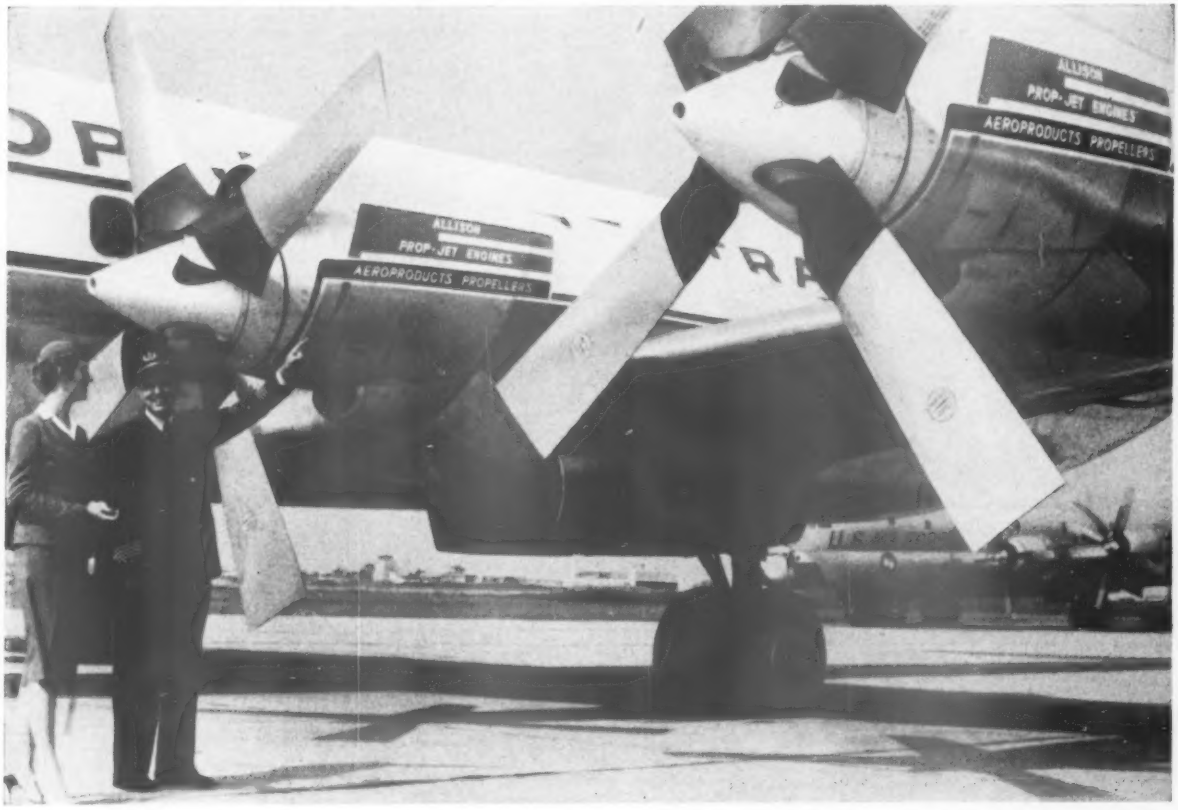

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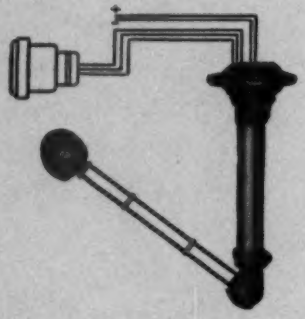

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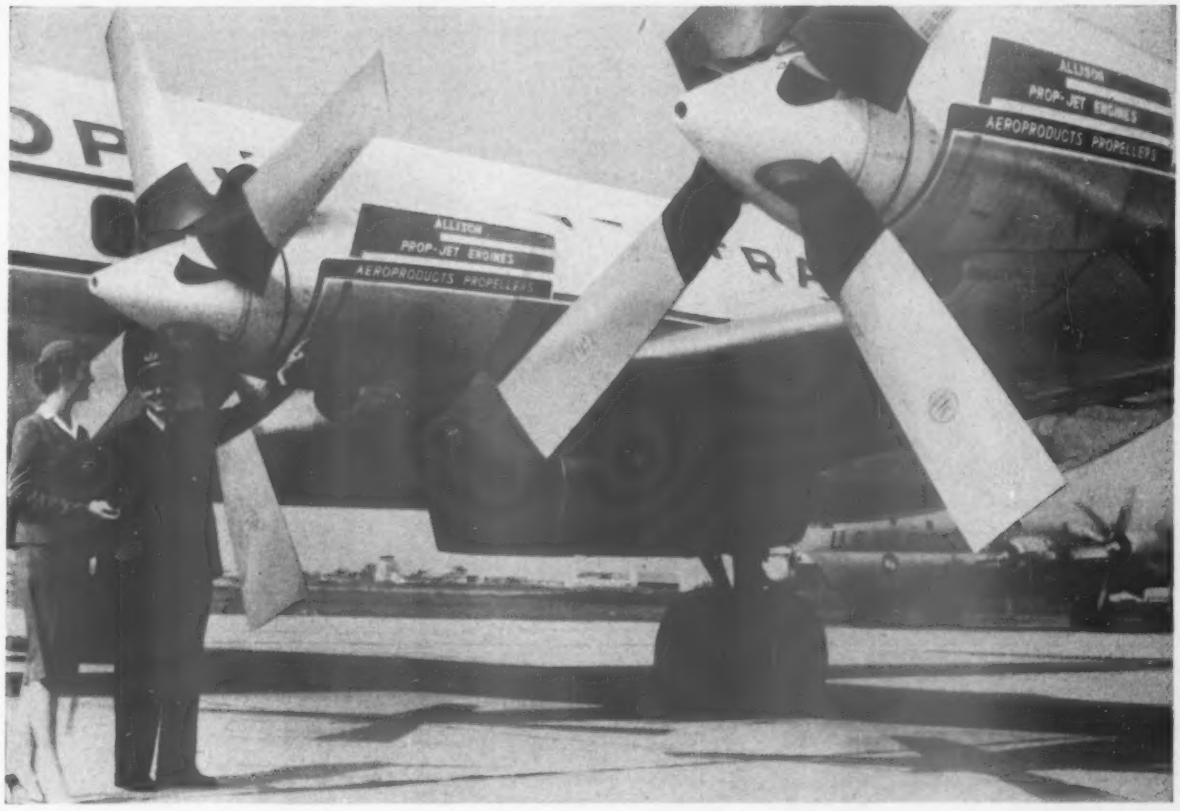

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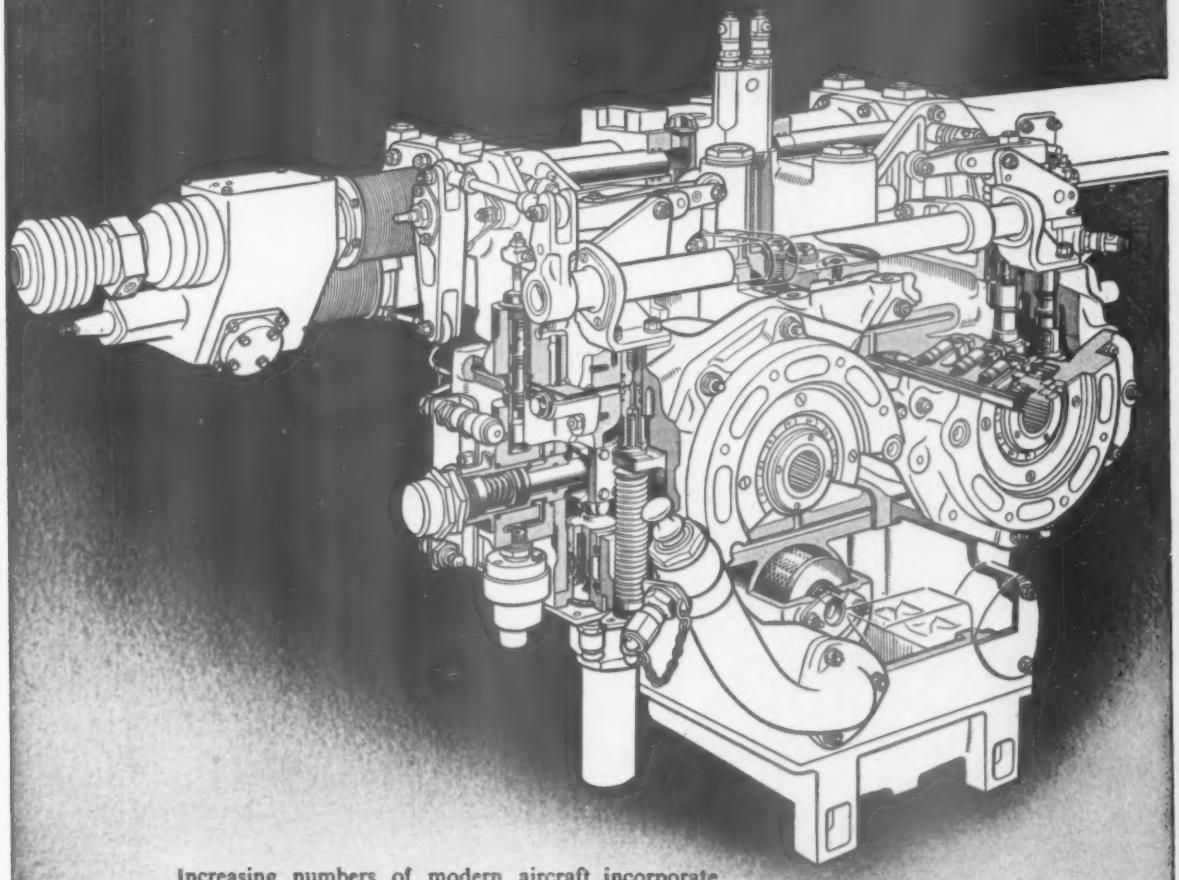

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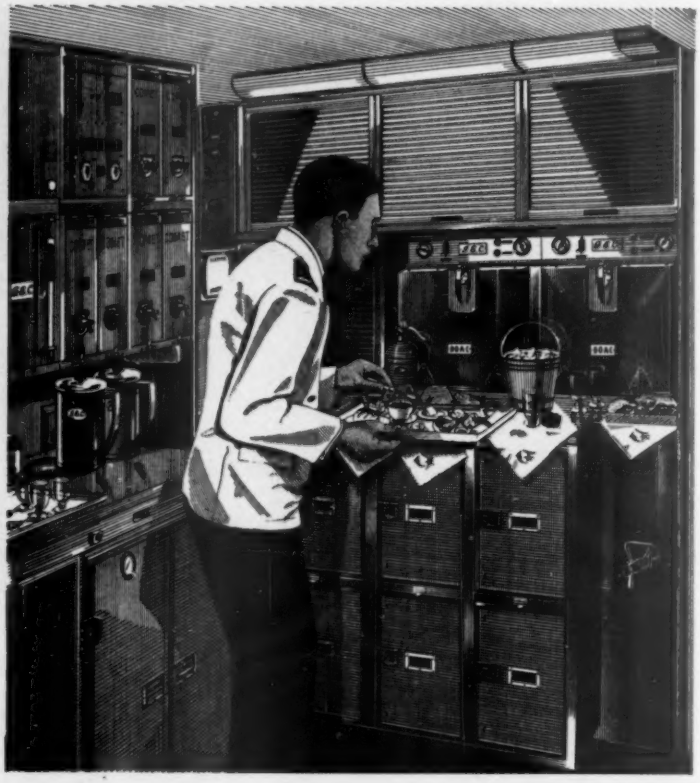

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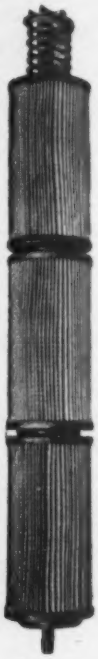

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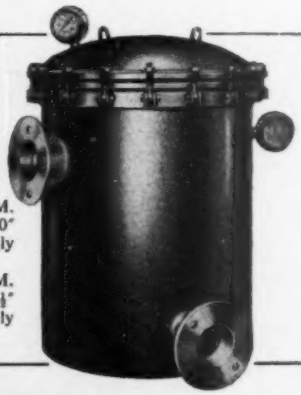

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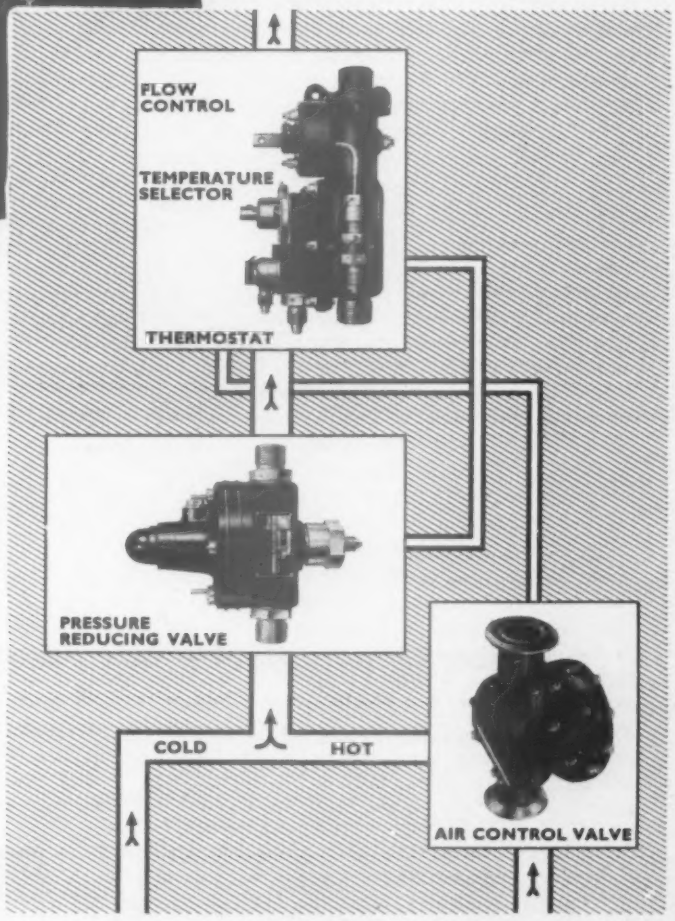

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TRAINING PILOTS FOR THE FUTURE

FOR many years far-sighted people have been talking of the need to provide a training establishment from which should graduate the next generation of airline pilots. The matter becomes more urgent every year and the lack of any firm planning became startlingly apparent on the publication of the 1957 White Paper on Defence which announced the intention of the Government to order no more manned fighters. It is true that the position has been much clarified since then. The Air Ministry has been at pains to emphasize that pilots will be needed by the R.A.F. as far ahead as anyone can see to plan. In passing, it is to be noted that an increasing proportion of such pilots will be needed for the services of R.A.F. Transport Command.

Recently, reports in the newspapers have disclosed the progress which is being made with a scheme to set up an air pilot training centre in which the Corporations and M.T.C.A. and the Independent operators would all have a say in the management. One way of doing this would be to have a board of governors, as does, for instance, the College of Aeronautics at Cranfield. The day-to-day running would be in the hands of a professional staff. Such a plan could be based on the acquisition of the A.S.T. organization at Hamble. However, the enthusiasm of M.T.C.A. and Corporations alike will go for nothing until the support of the Treasury can be obtained. And that has not yet been done.

Some illuminating figures have recently been published about the cost of military pilots. According to the Report of the Comptroller and Auditor-General the cost of putting one student through a course of one year at the Empire Test Pilots' School amounts to £30,000. This, it is to be noted, is not the cost of training an R.A.F. pilot from the *ab initio* stage but solely the cost of providing training on the latest types of aircraft for pilots with first-class flying ability and considerable general flying experience. The object of the School is to produce from such material for the experimental establishments of the M.o.S. and for the aircraft industry generally, pilots capable of undertaking the highest range of experimental and research flying. We seem to remember hearing a long time ago that the cost of training an R.A.F. pilot to fly operationally was of the order of £20,000.

It may be argued that it is not necessary to consider the training of pilots for civil operators in the same high-cost manner. Yet on the other hand it is equally not to be thought that the necessary standard of training is to be achieved by training civil pilots on small piston-engined aeroplanes with a conversion course on to jet trainers. A fundamental requirement for commercial pilots is adequate flying hours on the airways.

At this stage in the discussion, and such discussions are to be heard going on all over the place at the present time, somebody is bound to ask whether this is not where Transport Command comes in. First, there is the widely accepted argument that welcome though the plans are for the expansion of the carrying capacity of Transport Command they still do not go far enough, and there is a great deal of official air transport work which the Command might usefully do. On top of this there is the also widely accepted point that the excellent development flying of the Comet 2s by Transport Command foreshadows the way ahead which should be followed as being the most practical method of getting the necessary development flying done for the new generation of British civil aircraft. Of course, if some scheme could be worked out whereby the development flying of the new airliners is done by Transport Command then the problem of how to ensure that the civil trainees get in the necessary hours flying modern air transport in similar conditions to those obtaining on the airways would be solved. It would remain to work out some plan whereby pilots under training could serve in Transport Command either on a Short Service basis, or perhaps more satisfactorily as members of a Reserve.

As in any war communications play a vital rôle, such a Reserve would seem to have much to commend it. At all times in our history, the power of the Navy has directly depended on its ability to establish and maintain communications by drawing on the reserves of trained seamanship in the Merchant Navy. Of course, there is a school of thought which argues that the proper development of a Merchant Air Fleet has been sadly lacking in this country. It is difficult to see how such a scheme could have been made to work; indeed, after their recent experience with trooping contracts, the Independents might well be excused for deciding that the idea of a Merchant Air Fleet to form the basis of expanded air transport capacity in time of war is not regarded seriously at all by those in authority. It seems then that this lack of official faith in the potentialities of a Merchant Air Fleet could be the determining factor in the establishment of a Civil Air Pilots training centre.

The problem is not an easy one and there is bound to be much more discussion before the Air University scheme is finally solved.

Matters of Moment

Fiddling with Export Potentialities

ELSEWHERE in this issue we publish particulars of the new Tyne-engined Rotodyne for which an order of five with an option on fifteen more has been placed by New York Airways. According to reports from New York the letter of intent has been accompanied by a deposit of $25,000. Some time ago we reported the intention of Okanagan Helicopters of Vancouver to buy one Rotodyne with an option on two more. On the day that the news reached this country, Mr. Aubrey Jones, Minister of Supply, issued a statement which made it clear that B.E.A. have not yet signed their order, which is expected to be for six Rotodynes with an option on a further 14.

According to the official statement, an agreement provides for a Government contribution of 50% towards the remaining cost of development of the Rotodyne up to a fixed maximum. A levy related to the Government contribution will be payable to the Government on sales of the aircraft. The agreement is conditional on a B.E.A. order for the aircraft. Thus at this stage there is no Government support and no B.E.A. order.

It is just this dithering and dallying which in the future may be expected to provide a nasty shock in our export figures. Government departments seem oblivious of the fundamental fact that the air exports of today are the result of R. and D. expenditure of ten years ago. So exports are still living on the fat provided by the previous Government. Failure to press on with the development of the Rotodyne must reduce its chances in the export market. Moreover, already its hard-pressed manufacturers have negotiated a deal with an American company so that it now seems certain that large sales in the United States will no longer benefit the workers in this country to the extent that might once have been the case. And once production of the fastest rotary-wing aircraft in the World gets going in the United States, nobody here will be able to compete.

It has always seemed a matter of regret to us that civil helicopter operation should have been left to B.E.A., which operator is primarily interested in fixed-wing aircraft. What might the position have been today of not only the Rotodyne, but of other British helicopters, if we had had an autonomous Board charged with developing internal rotary-wing air services?

Gold-plated Planet

PIONEER IV, the U.S. lunar probe launched from Cape Canaveral on March 3, missed the Moon by some 38,000 miles, according to reliable estimates, but nevertheless did much to restore American prestige in the eyes of the World. Unlike the Soviet Moon probe, "Lunik," launched on January 2, whose precise whereabouts were never confirmed outside the Soviet Union, Pioneer IV's signals were received "loud and clear" all the way by Jodrell Bank.

The gold-plated glass-fibre cone containing the probe radio transmitter and instruments weighed 13.4 lb. and is, therefore, the second smallest artificial satellite. It needed a 60-ton four-stage rocket to boost it to 24,890 m.p.h., a speed sufficient for it to escape Earth gravity and later enter into an orbit round the Sun. If its batteries last, scientists hope to track its course with the Jodrell Bank radio telescope until it is at least 500,000 miles from the Earth.

Meanwhile voices are being raised in various quarters challenging the validity of the Soviet claim that their probe passed within 5,000 miles of the Moon. In fact the whole affair is rapidly becoming something of a mystery. Signals of a kind, possibly not telemetry, were apparently monitored by various stations in the U.S. during its flight, but no one will admit to have positively identified them. Their frequencies were certainly not those belatedly put out by the Russians, and Jodrell Bank searched but picked up nothing, though in a good position to do so as Lunik neared the Moon.

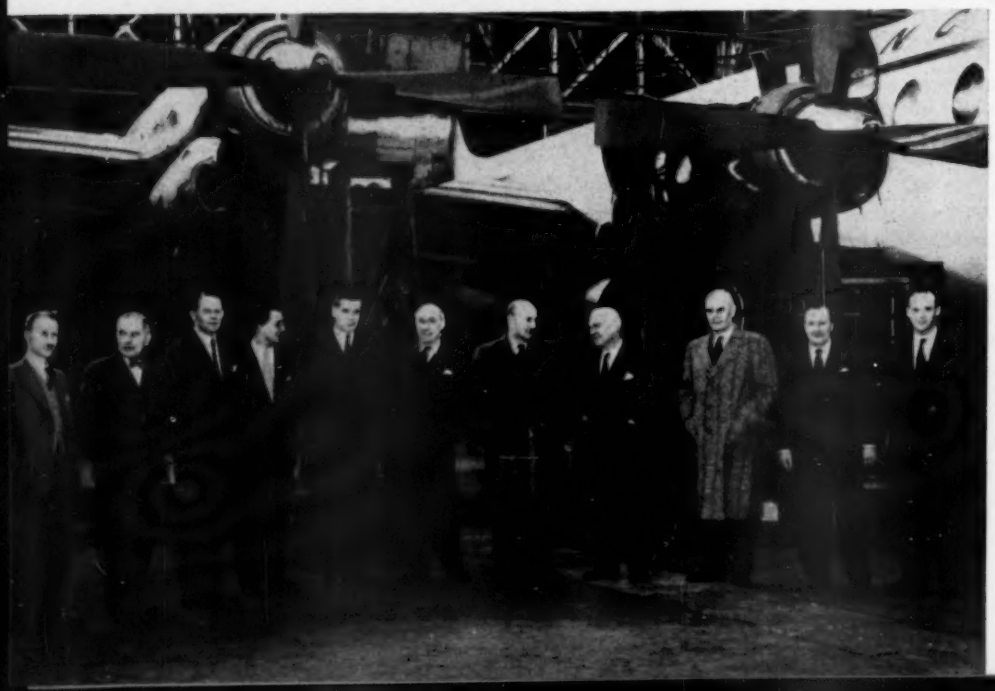
Considering the alleged weight of Lunik's payload (796 lb.) its batteries very conveniently gave out after an exceedingly short life, and unless they were triggered by a Soviet command signal their claim to have tracked the probe well past the Moon cannot be substantiated. The Russians have only themselves to blame if the World is somewhat sceptical. They have never advertised their failures in the past, though it is now believed that Lunik was at least their fourth attempt to launch a probe since Sputnik I.

It is to be hoped that the results they obtained, which are of scientific interest to the whole World, will be as speedily published as the special postage stamp that was issued to commemorate the event.—I. G. WHY

Arrow Aftermath

CANCELLATION of the Avro Arrow all-weather supersonic fighter and its Orenda Iroquois turbojet engines earlier this month (THE AEROPLANE for March 6) still forms a major, and contentious, topic in Canada. Public reaction, writes our Canadian correspondent, has ranged from vitriolic criticism of the Government from laid-off employees to enthusiastic congratulations of the Government's courage from less-interested parties.

The most recent news is that about 1,000 engineers, scientists and technicians will be called back to the Avro Aircraft and Orenda Engines' plants at Malton, near Toronto. The Government will pay half their salaries for six months as a means



B.I.A.T.A. AT WEYBRIDGE.—During a visit to the Weybridge Works of Vickers-Armstrongs (Aircraft) Ltd., last month, B.I.A.T.A. council members saw Vanguards and Viscounts in production and also inspected the first Vanguard at Wisley. Left to right: Mr. E. L. Moore, Dan-Air Services; Mr. E. C. Mekie, British Aviation Services; Mr. G. H. Freeman, Transair; Mr. A. M. Blakemore, B.I.A.T.A.; Mr. R. L. Cumming, Airwork; Mr. C. J. Stevens, B.K.S. Air Transport; Sir George Edwards, Vickers-Armstrongs (Aircraft), Ltd.; Mr. E. Rylands, Skyways; Mr. R. C. Handasyde, Vickers-Armstrongs (Aircraft), Ltd.; Mr. T. W. Morton, Morton Air Services; and Mr. G. Page, Vickers-Armstrongs (Aircraft), Ltd.

GOING ON TOUR.—This new air-to-air picture of the Handley Page Dart Herald has special interest because the prototype is due to leave next month on a demonstration tour of Europe and Asia. Sqn. Ldr. H. G. Hazelden will be the Herald's captain on this first series of overseas demonstrations.

of retaining a nucleus of skills. This group is in addition to the 2,000-odd people who have been recalled after the entire staffs of 13,800 were discharged by the company on February 20.

In view of the decision to standardize on the U.S. Bomarc missile and SAGE system, it had been hoped that the United States would place substantial defence contracts in Canada to take up the slack. The $1,700,000 contract just awarded to Canadair for Bomarc wings and ailerons is considered a poor token. However, the American aircraft lobby is extremely strong, and would bitterly resist any major contract going to Canada.

Mr. Pearkes, the Canadian Defence Minister, has said the Bomarc could fly higher and faster than the Arrow, although the latter was more flexible. Mr. Diefenbaker said that the cost of Bomarcs to Canada would be $19,800,000, compared with $781,000,000 for Arrows.

Crawford Gordon, Jr., president of A. V. Roe Canada, Ltd., has stated that his company suggested several programmes to the Government. Among these was an ambitious proposal to design a Viscount replacement for T.C.A., the R.C.A.F. and for export. Mr. Diefenbaker said that Avro proposed that if T.C.A. would guarantee to take 25 aircraft and the Government would put up $30,000,000 for engineering and development, a jet transport could be made available for $2,500,000 each.

Another proposal was the acceleration of Project Y, the VTOL aircraft sponsored by the U.S.A.F. The Canadian Government withdrew support for this project in 1954, after having spent millions of dollars on it. Said to be similar to the Chrysler design with two ducted fans, the prototype may fly by June.

News from Canadair

FROM Canada last week came the news that Canadair has received a firm order from "a United States all-cargo operator" over the North Atlantic for five Tyne-powered CL-44D all-cargo aircraft, with an option for five more. The Flying Tiger Line are very interested in this aircraft, and in the very near future Canadair hope to have an order for 10 aircraft from them. There are high hopes in Montreal that the CL-44D will prove to be the vehicle that air cargo operators have been waiting for—and waiting for a long time.

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Agriculturalists at L.A.P.

WITH the holding of the second provisional meeting of the recently formed Agricultural Aviation group on March 6 at London Airport, further convincing evidence of the growing importance of this specialist business has been forthcoming. Readers will recall that the group, headed by Mr. S. W. G. Foster, a design consultant, held its inaugural meeting last month and got off to a promising start. At this second meeting the earlier promise seems to have been fulfilled for no fewer than 35 people were present and included research workers, aeronautical engineers, pilots, technicians, chemists, entomologists and farmers.

The proceedings were opened by the showing of four films. The first "The Rival World" illustrated the problem of insect pest control and showed aerial spraying against locusts on the wing. Next came a film "Operation Cockchafer" which showed fruit spraying in Switzerland. The third film was a documentary on spraying practice; and the final one was of the Agricultural Aviation Show held in New Zealand.

Discussions followed the films and ranged over a wide variety of subjects, taking in such things as the aircraft available; the chemicals used; safety of operation and the accident rate; and safety requirements. These last-named problems were given a good deal of attention and there was much discussion of the need for low stalling speed and effective stall warning indicators. Indicators used in America were described—but it was explained that one of the problems was that of correctly locating green and red indicator lamps; the concentration by the pilot made this difficult to achieve. Mr. Foster himself suggested the simple solution of using an audible warning device which would relieve the pilot of the need to watch for lights and indicators.

Performance requirements for agricultural aircraft were also discussed in some detail and the question of climb gradient was raised. It was felt by one speaker that a 15% gradient might not be too little for some operations in hilly areas. A rate of climb figure of 1,000 ft./min. was suggested as being very useful to the pilot under certain conditions; helicopters were mentioned as being particularly useful in this respect.

A representative from the Air Registration Board stated that the present ARB requirement on climb gradient was only 4%. This, he agreed, appeared to be rather low for agricultural work of the nature discussed.

Another speaker, dealing with the subject of "What does the operator expect from the aircraft?" answered the question by saying that the aeroplane should cost nothing to build, nothing to operate and nothing to maintain. More seriously, he suggested that it must be extremely simple both from the flying point of view and from the maintenance aspect. The aircraft must, he said, be versatile because of its high capital cost—with due regard paid to all the year round utilization.

There were 13 operators in this country employing about 36 aircraft. The requirements were widely differing and it was an extremely difficult task to formulate exact requirements for different parts of the World.

The Cambridge Air Squadron Dinner

THE biggest surprise of the twenty-seventh annual dinner of the Cambridge University Air Squadron was not to hear the Chief of the Air Staff make no promise of providing more advanced aircraft for training but to hear the member replying for the Squadron say they were well satisfied with the Chipmunks and grateful to those who made it possible for members of the Squadron to fly them. It is a remarkable thing that the advent of the missile should have so worked on affairs that the young men of the University no longer feel that jet-engined trainers are a "must."

On these annual Cambridge occasions the procedure is that the Commanding Officer of the Squadron takes the opportunity in toasting the guests to say something of the Squadron's progress. This year the Vice-Chancellor, Lord Adrian replied. Then the Chief of the Air Staff, in proposing the health of the Squadron, has something to say on Air Ministry policy and in thanking him, the Squadron member who replies makes reference to various Squadron activities which are generally better understood by the members of the Squadron than the guests—though many of the latter, no doubt, are able to recall similar episodes in their own experience.

In his short speech on March 6, LORD ADRIAN, the Vice Chancellor, remarked: "The University would be a pretty poor sort of place if nobody thought of anything except the Tripos. We hope our hosts will all get Firsts but we are prepared for some disappointments." Before this the Commanding Officer, WG. CDR. J. E. P. THOMPSON, had welcomed the guests and in so doing had disclosed that the Chief of the Air Staff and himself had one thing in common, in that neither had had a university education. He reflected though, that on balance the C.A.S. seemed to be doing the better of the two. On air matters he said that though the Squadron was now half the size it had been in 1957 it had achieved some 5,000 hours' flying during the year under review. It had been runner-up for the Hack Trophy.

In his speech, MARSHAL OF THE ROYAL AIR FORCE SIR DERMOT BOYLE recalled the days when Cambridge was so self-sufficient that it had rebuffed attempts to provide it with a railway station, but coming rapidly forward to this space age he made it clear that every year the Royal Air Force would require an intake of 400 to 500 pilots, 250 navigators and some 100 electronics officers. He assured his hearers there was a full career of flying ahead for the young officer.

A Change in Scientific Appointments

NO announcement from the Air Ministry was available as we went to press about the filling of the post of scientific adviser to that department left vacant by the appointment of Mr. Stewart Scott-Hall to a new post. We understand that the latter is leaving shortly for Australia to take up the post of scientific adviser to the U.K. High Commissioner there, in place of Mr. W. H. Wheeler, who has held the appointment since February, 1956.

The Rising Price of Development

LAST WEEK, publication of the Civil Appropriation Accounts for 1957-58 focused its annual rather bright spotlight on the ever-rising costs of aircraft and aero-engine development during the past few years. Not only does this Report of the Comptroller and Auditor-General indicate the difficulties of forecasting expenditure on new projects, it draws attention also to the high price that sometimes has to be paid for changes in official requirements and contract conditions.

In one particular case—that of the Bristol Orion turboprop engine—the large sum of money spent on its development did not bear production fruit, as the project was brought to an end at a comparatively early stage after £5m. had been spent on it.

When the Orion was first proposed as a later engine for the Britannia, the development contract in 1954 was awarded on the basis of a cost of £6.5m. to be spent over six years up to type test. In March, 1957, the estimated cost up to type test in 1959 had risen to £12.9m. Of this increase, £3.65m. was the result of underestimating the cost of the work to be done and to overlooking the need for an additional six engines for the test programme.

At this time, sales prospects of the Orion were good—B.O.A.C., for example, had undertaken to buy 60—and the recovery of the development expenditure seemed likely. However, late in 1957, the Report explains, the Ministry of Supply and Bristol Aero-Engines found that "for technical reasons" advantage could not be taken of the increased power of the Orion as a Proteus replacement in Britannias without modifying the wing—with consequent expense and delay—and that even then there would not be much improvement in speed and range. In January, 1958, then, when the R.A.F. decided to keep to Proteus engines for its second squadron of Britannias and B.O.A.C. asked to be relieved of their obligation to buy Orions, the M.o.S. decided to discontinue financial support.

In that part of the Comptroller's Report which deals with Comet 4 and Avon RA.29 development costs, it is interesting to note that in 1955 the Treasury agreed to the M.o.S. contributing £1.7m. towards the airframe development costs and sanctioned £2.36m. to be spent on the RA.29, including the cost of supplying engines for the development programme.

By the end of 1956 the cost of the engine programme had risen to £7.6m.—the increase being partly due to the fact that structural difficulties prevented more than two RA.29s being installed in a Comet 2—with consequent delay to the programme. Also, the original estimates had included only two of the four years' expenditure, because of the difficulty of foreseeing how much work would be required for the later years. Design changes, increased manufacturing costs, and wage increases are also mentioned as contributory factors.

A rather more surprising increase in development cost is represented by the figures quoted for the Sea Vixen contracts. In 1953, the total estimated cost for a naval version of the D.H.110 was £1,325,500, and a contract was placed. In March, 1955, the contractor notified the M.o.S. that all the previous estimates had been ill-founded and that the cost would be £3,092,000. A further increase to £3,675,000 was reported in January, 1957, because of an extension of the programme of work under the contract. The following month the Ministry told the Treasury that, in addition to the prototype contract, then standing at £3.7m., a further £1.28m. would be needed to bring the aircraft to an approved release standard.

The Treasury, after discussion, authorized expenditure up to £4.2m. for the main prototype contract which, having been extended, the Report says, to cover some part of the additional work, was terminated in October, 1957.

In February, 1955, an order was placed for three Sea Vixens for development work with the M.o.S. air fleet and for a production quantity for the Admiralty.

In June, 1957, the M.o.S. reported to the Treasury that the estimated cost for aircraft had risen by about 85%. Reasons given include more accurate estimating as knowledge of the aircraft increased; new manufacturing techniques to cope with weight restrictions; increased complexity of design; wage awards; and increased overheads due to reduced production.

It appears, the Report goes on, that from a routine return of estimated costs made to the Admiralty in June, 1958, that there have since been further substantial increases in cost. "I have asked the Ministry," says the Auditor-General, "for information as to the steps taken by them to check the make-up and substantial accuracy of the contractors' estimates before the development and production contracts were placed; and on what grounds they were satisfied that these estimates could be relied upon as providing a reasonable basis on which to obtain authority to proceed with development and production."

The Report cites a case, unnamed, of a contract covering the development at an estimated cost of £60,000 over four years, of "a new and complex type of radar scanner." The contract provided also for three development models.

An amendment to the requirement in 1953, coupled with the addition of one more development model and 20 prototypes put the estimated cost up to £350,000. In January, 1954, seven models instead of four were called for, and in October of that year the cost had gone up to £742,000. In September, 1955, the Ministry reported that six of the development models did not fully meet requirements, but would be used for laboratory work; that 17 development models were now required; and that the provision of test and maintenance gear would incur additional costs. The estimate of total cost went up accordingly to £1.25m. In November, 1956, expenditure of £1.63m. was sanctioned—allowing for a reduction in the number of prototypes by four. This figure was later revised to £1.9m.

In March, 1957, the contractor estimated the cost of each of the remaining units on order at more than five times the original estimate, excluding cost of tools and test equipment. The present estimated cost per unit, including tooling and test equipment, is eight times the original figure.

New World Rotodynes

FROM the Fairey company last week came the stimulating news that they had received an order from New York Airways for five of their Tyne-powered Rotodynes—with an option on 15 more. According to the official statement this transaction was disclosed by New York Airways to America's Civil Aeronautics Board during the official hearing for the renewal of the operating company's five-year licence for their city-centre helicopter services from New York to a number of New England towns. The first five aircraft are to be delivered by the early spring of 1964 and Faireys expect the first aircraft to fly in the autumn of 1961; a cost in the region of £500,000 each has been quoted.

With this announcement has come some more information about the new and more highly powered Rotodyne which forms the subject of this order. With accommodation for up to 65 passengers—or 18,000 lb. of freight—it is dimensionally bigger than the 48-seat prototype. The fuselage length has been increased from 58 ft. 8 in. to 64 ft. 6 in. and the overall height has gone from 22 ft. 2 in. to 23 ft. 2in. The rotor diameter is now 104 ft. instead of 90 ft.

Powered by two Rolls-Royce Tynes delivering 5,000 s.h.p. each, the new Rotodyne will have an all-up weight of 50,000 lb. (which is 17,000 lb. heavier than the present machine powered by 2,800-h.p. Napier Elands).

With a normal load of 57 passengers (or 15,000 lb. of freight) the Rotodyne can operate over a 250-mile stage at more than 200 m.p.h. with full allowances. With the maximum passenger or freight load (65 or 18,000 lb.) the stage distance would be 120 miles; the maximum range will be 650 miles. Operating cost is quoted at approximately 3.75d. per passenger seat-mile.

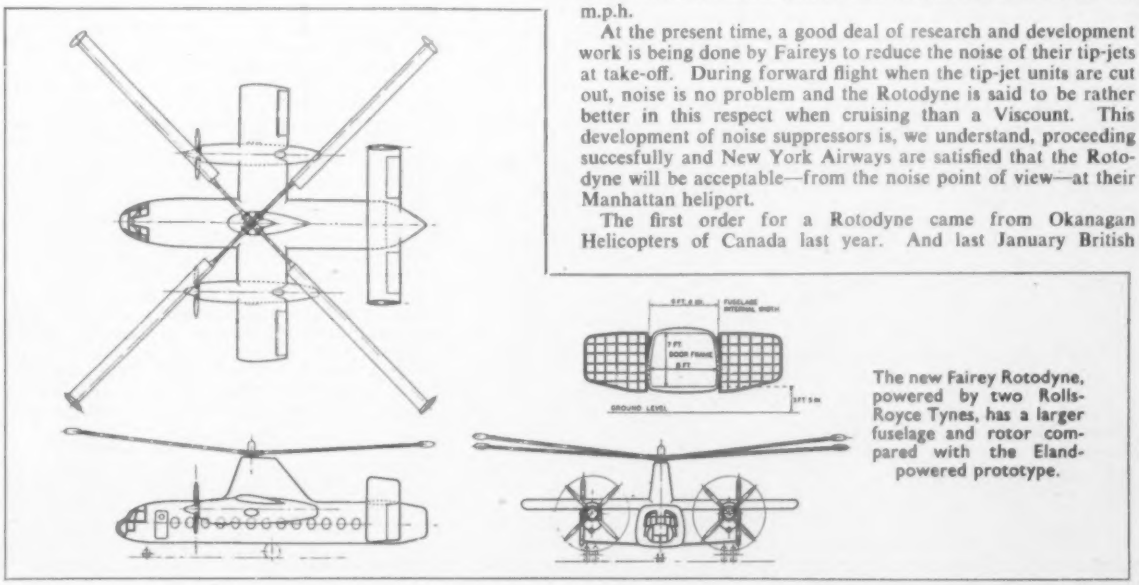
Kaman Aircraft Corporation of Bloomfield, Connecticut, are sales and servicing agents for the Rotodyne and have a manufacturing licence for the aircraft in the United States. However, although Kaman will be closely concerned with this order and indeed, have had much to do with the negotiations leading to it, the Rotodynes for New York Airways will be built by Faireys in the United Kingdom. It may be, however, that later on production of Rotodynes will be undertaken by Kaman.

New York Airways started operating scheduled helicopter passenger services between La Guardia, Idlewild and Newark airports in the New York area in July, 1953. Since then their services have been extended to places in Connecticut, New Jersey and New York State: and in December, 1956, passenger services into the new Manhattan heliport were inaugurated. Some indication of the company's scope and size is given by their 1957 total of 69,000 passengers carried; 1,275 U.S. tons of mail and 1,100 U.S. tons of freight.

Readers will recall that the prototype Rotodyne powered by Elands made its first flight in November, 1957, and made its first transition into complete autorotative flight in April the following year. To date, in 63 flying hours, it has completed 174 flights and 210 transitions. Last January the Rotodyne achieved the distinction of setting up (subject to F.A.I. confirmation) a 100-km. closed-circuit World class record of no less than 191 m.p.h.

At the present time, a good deal of research and development work is being done by Faireys to reduce the noise of their tip-jets at take-off. During forward flight when the tip-jet units are cut out, noise is no problem and the Rotodyne is said to be rather better in this respect when cruising than a Viscount. This development of noise suppressors is, we understand, proceeding succesfully and New York Airways are satisfied that the Rotodyne will be acceptable—from the noise point of view—at their Manhattan heliport.

The first order for a Rotodyne came from Okanagan Helicopters of Canada last year. And last January British

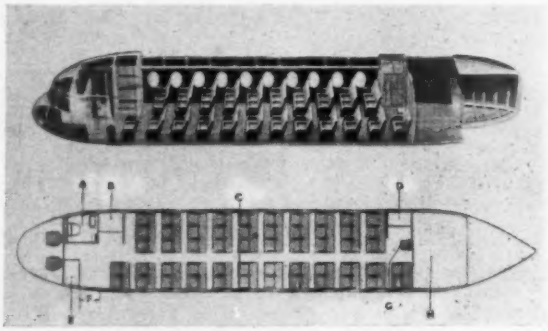


The new Fairey Rotodyne, powered by two Rolls-Royce Tynes, has a larger fuselage and rotor compared with the Eland-powered prototype.

European Airways announced their intention of buying six—subject to the aircraft meeting the Corporation's operating requirements.

Although to begin with the Fairey company received some financial support for the Rotodyne prototype from the Ministry of Supply this was later withdrawn and the company was left to continue development of the aircraft—the World's first VTOL airliner—as a private venture. Subsequent efforts on their part to get further Governmental support seem, however, to have borne some fruit. The Minister of Supply has now stated that a contribution of 50% of the remaining development cost of the new version of the Rotodyne up to a fixed maximum is to be made by the Government. But this is conditional on the B.E.A. order for the aircraft; so until the Corporation takes its final decision, the financial help that Faireys want will not be forthcoming.

Meantime, it has been left to an American air transport operator to plan the first scheduled operation of a British VTOL passenger craft.



ROTODYNE INTERIOR.—A=Toilet. B=Suitcases. C=Rotor centre-line. D=Pantry. E=Radio. F=Door. G=Flight attendant's folding seat. H=Freight/mail/registered baggage.

Fairey—the Private Venturer

A LARGE and distinguished audience gathered at Feltham on March 5 to hear Mr. Geoffrey Hall, chairman and managing director of the Fairey Aviation Company, Ltd., deliver the first Fairey Memorial Lecture to the L.A.P. Branch of the Royal Aeronautical Society; the president of the R.Ae.C. and at least four past presidents were there to hear him. His subject was Sir Richard Fairey. Sir Frederick Handley Page, a close friend and contemporary of Sir Richard, moved the vote of thanks.

In these days of education State-provided up to manhood it is worth pondering on the extent to which Sir Richard Fairey's success may be traced to the difficulties which he had to overcome in educating himself. Born into a well-off family with the expectation of public school and university education, he lost his father when he was but 11 years old and by the time he was 15, having had to leave school, he was getting 5s. a week as an apprentice. He went to night school at the Finsbury Technical College.

Duly passing his examinations, a swollen head and a strong inclination for individual action cost him the sack from the firm to which he had been apprenticed but he next got a job as an analytical chemist. It was when he was a young man playing with aircraft models that H. G. Wells, the writer and novelist, used to talk with him. In 1910 a turning point in his life occurred when, having entered the Model Aeroplane Competition at the Crystal Palace, he not only won the Challenge Cup but various Gold Medals as well. As a direct consequence he sold his design, a twin-screw elastic-driven monoplane canard, to the model aeroplane department at Gamages. Mr. Hall's story of the acumen with which he did this showed how well equipped the young electrical engineer was for a business career.

The money earned by down payment and licence fees enabled him to give up his job with the Finchley power station and down he went to Eastchurch on the Isle of Sheppey to join J. W. Dunne who was building autostable aeroplanes with swept-back wings. It is worth noting that in his winning Crystal Palace model the young Dick Fairey had inadvertently infringed some Dunne patents by using varying incidence throughout the planform and when Gamages put the model into production it was under licence from Dunne. Some examples of similar Fairey models were on show in the lecture room and examination of them showed his dexterity with his hands. Indeed, we have heard a former colleague of his say that he could well have been a surgeon.

At Eastchurch the young Fairey met the Short brothers and Horace Short, whom he regarded as the greatest engineer he ever knew, persuaded him to join them in 1913. While with this pioneer firm he met three young men—Nicholl, Dawson and Wright—with whom he was later to form his own firm. This occurred in 1915 when he left the firm of Short Brothers and received a sub-contract. Thereafter the Fairey series of aircraft grew and prospered. Their story is given by Mr. Hall in his paper in some detail but we must go on to the Schneider Trophy Race of 1923.

For the benefit of those who have grown up since 1931 we must explain that this classic race was the outcome of the presentation of a trophy, now permanently in the keeping of the Royal Aero Club, for international competition to improve the breed of seaplanes. The struggle eventually became so strenuous that national Governments participated. It was finally won in perpetuity for Great Britain in 1931.

In 1923 the race was won by a Curtiss CR-3 biplane of the U.S. Navy. The clean lines made possible by the Curtiss D12 12-cylinder Vee engine fascinated Fairey and, failing to get the support of the British Government for the building of a new two-seat biplane bomber which he was convinced would be faster than any fighter then in existence, he raised all the money he could, went to the United States and returned with the rights for the Curtiss D12 engine, the Reed all-metal propeller, steam cooling and many other design features.

He then set to work and as a private venture produced the Fairey Fox, which justified his claims and upset a lot of people in the process. In passing, it is worth noting that in those days of flying Christmas trees, when equipment was hung all over the aircraft, Fairey insisted on the development of a retractable gun-mounting to replace the ubiquitous and drag-producing Scarff-ring. His reward for being so obstinately successful was an order for only 18 aircraft. The outcome was an Air Ministry specification put out to tender and the appearance of the historic Hart.

Not to be defeated, and to recover the money invested in the Fox, Fairey sold a development of the Fox to the Belgian Air Force and so brought about the beginning of Fairey's Belgian subsidiary.

It was at this period that the Fairey badge came into being from the Fox's head adopted by No. 12 Squadron, who were equipped with these sensational aircraft. It is difficult to realize now the impact of the Fox on British military aircraft design, but even in those days the amount of money required to indulge in such a private venture undertaking was very considerable and, as the outcome of the story shows, there was no automatic return on the investment.

Fairey's zest for private enterprise was nowise damped and it is to be remembered that the Fairey Gyrodyne which established an F.A.I. speed record for helicopters in 1948 of 124.3 m.p.h. was a private venture. From this has directly been developed the Fairey Rotodyne which, at last, with two orders from the New World, seems nearer adoption in the Old World as well. But the story has jumped too far ahead and we must go back to the Fairey T.S.R. Mk. I of 1933, of which the prototype crashed. Work was continued on it as a private venture (that obstinate faith in Fairey judgment) and in due course the design became adopted as the Swordfish, which is as certain of a place in history as any other aeroplane, and more than most.

It is good to think that Sir Richard Fairey lived to see the day that the Fairey Delta 2 by achieving a World speed record of 1,132 became the first aircraft officially to achieve over 1,000 m.p.h.

We have no space here to even outline his whole life.

Though that story was told broadly at the time of his death in September, 1956, the biographical account, which, as Sir Frederick Handley Page said in moving the vote of thanks, had been so sensitively told by Mr. Geoffrey Hall, not only forms a fitting tribute to a great man, but is certain to inspire each new generation of members of the Royal Aeronautical Society for a long time to come.

General Aviation News

HELICOPTER POWER.—Mr. H. Buckingham, managing director of the de Havilland Engine Co., Ltd. (left) and Mr. D. L. Hollis-Williams, technical director of Westland Aircraft Ltd., disembarking after a flight in an experimental Whirlwind which has been modified to take the D.H. Gnome shaft turbine.

LISBON FAIR.—The Air Ministry is proposing to send 18 R.A.F. aircraft to Lisbon for the trade fair in May. Altogether 175 Service personnel are expected to go with the detachment.

R.A.A.F. SIDEWINDERS. — The R.A.A.F. has received an experimental consignment of U.S. Sidewinder AAMs. The Australian Government is expected to purchase several hundred more during the next two years to equip its Sabres.

JETSTAR CERTIFICATION. — Preliminary tests for certification of the Lockheed JetStar by the F.A.A. will begin this year, and a full C. of A. is expected next year. Production models are scheduled for delivery early in 1961.

MALAYAN AIR FORCE.—Three gift aircraft—two Prestwick Pioneers and one Twin Pioneer—from the United Kingdom to the Royal Malayan Air Force arrived in Kuala Lumpur recently. The R.M.A.F. already had one Twin Pioneer.

NAPIER APPOINTMENT.—Mr. J. F. W. Bowskill has been appointed D. Napier and Sons' technical representative for South, Central and East Africa. He succeeds Mr. P. S. Deary, who has been the company's representative for the past four years.

SPUTNIK'S 4,000 CIRCUITS.—Sputnik 3 completed its 4,000th revolution round the Earth on February 27. In its nine-and-a-half month existence it has travelled nearly 115 million miles.

GERMAN AIRSHIPS.—Two German non-rigid airships, the Underberg and the Trumnf, will be flying this summer. The Underberg will take the air about June, while the Trumnf, which flew for 164 hr. 31 min. between July and November last year, will be out towards the end of April.

VERTOL SUCCESS. — The Vertol Aircraft Corp. has won the design competition for a heavy transport helicopter for the U.S. Army. A contract is to be negotiated with Vertol for this new 2-3-ton capacity helicopter, the YHC-1-B, which will be known as the Chinook; it is the largest multi-engined helicopter yet specified for the U.S. Services.

CARIBOU STRETCH.—Gross weight of the de Havilland Caribou has been increased by 2,000 lb. to 26,000 lb. and the cabin length has been increased to 28 ft. 9 in. to accommodate 30 instead of 28 passengers. The two Caribou prototypes have flown nearly 400 hr. in six months of intensive test flying.

AUSTRALIAN MISSILE CAMERA.—Col. R. T. Elvish, manager of the Fairey Aviation Co. of Australia, is to seek sales in Europe and N. America for an Australian-made missile-tracking camera. A 35mm. camera for use in missile target aircraft, it has a special lens giving 180° coverage.

News About People

GLIDING AWARDS.—In addition to the awards reported on page 278 of last week's issue of THE AEROPLANE, the British Gliding Association has also announced that the Manio Cup, for the best goal flight of the year, goes to Mr. Paul Minton, for his 204-mile flight from Lasham to Great Yarmouth via Edgehill on May 11, 1958, in a Skylark 3; and that the California in England Trophy, for the longest flight by a woman pilot, goes to Mrs. Ann Burns, for her 192-mile flight from Lasham to Perranporth on April 12, also in a Skylark 3.

FLYING TROPHIES. — Various trophies and mementoes which were presented to Miss Amy Johnson, who made the first woman's solo flight to Australia in 1930, have been handed to Bridlington Corporation by her father, Mr. J. W. Johnson. They are valued at more than £1,000.

R. A. JOHNSON.—We regret to record that Mr. Reginald Arthur Johnson, in charge of sales of the bonded structures division of CIBA (A.R.L.), Ltd., of Duxford, was killed in a motoring accident near Daventry on February 22. He was 44. After serving his apprenticeship with Armstrong Whitworth he joined the Rover Co., Ltd., and went to Aero Research, Ltd., in 1949.

Mr. Laurence Malec who recently joined the Solartron Electronic Group Ltd. as managing director of Solartron Radar Simulators Ltd.

MILES APPOINTMENT.—Mr. B. T. Scott, until recently sales engineer with the Kestner Evaporator and Engineering Co., Ltd., has joined Miles Structural Plastics, Ltd., as sales development engineer. Miles are expanding their production capacity in the asbestos-phenolic and glass-fibre fields.

ELECTRONICS MOVE.—Mr. Peter Alsop, who has been working in an advisory capacity with E.M.I. Electronics, Ltd., for the past three years, has joined Technograph Electronic Products, Ltd., of Fleet, Hants, and is responsible for the technical sales division in the computer, guided-weapons and airborne-equipment fields.

N.R.D.C. APPOINTMENT. — On April 1 Mr. J. C. Duckworth, B.A., F.Inst.P., A.M.I.E.E., F.Inst.F., will succeed the Earl of Halsbury as managing director of the National Research Development Corporation.

MORE NEWS ITEMS WILL BE FOUND ON PAGE 317.

Mr. C. Boon (third from left) inspector-in-charge at the Hurn depot of Vickers-Armstrongs (Aircraft), recently retired after 44 years with the company. With him here are Mr. J. H. Heap, Mr. T. Gammon and Mr. R. E. Edmonds.

Air Transport

A Year-old Bombshell

THE facts given in a somewhat sensational article in last week-end's *Sunday Express* will not have been particularly surprising to those who have watched B.O.A.C. through the years and have compared its operating figures with those of comparable foreign airlines. It should be explained, nevertheless, that the figures and facts quoted in the article were drawn from a report which was issued for circulation within the Corporation more than a year ago.

They are, however, sufficiently interesting to be quoted—with reservations—at a time when B.O.A.C. is busily preparing to put its house in order and is likely, from all accounts, to be announcing a fairly startling deficit for the financial year which ends this month.

Briefly, the committee is reported to have found the Corporation to be inefficient on the engineering side when compared with K.L.M., United Air Lines and Pan American Airways, whose respective organizations were used as yardsticks.

Typical points made, according to the *Sunday Express*, were these: B.O.A.C. employed about three times as many engineering staff per aircraft as any one of the other three companies; the effective working week was 37½ hours, compared with 40 hours for the U.S. operators and 48 hours for K.L.M.; the cost of maintenance and engineering per aircraft/hour was £80, whereas the P.A.A. figure, adjusted to British cost-of-living standards, was £43; because of the complicated pattern of the organization B.O.A.C. had about three times as many administrative staff as the other companies and a very much bigger proportion of inspectors and stores staff; and there was no counterpart in K.L.M., U.A.L. and P.A.A. of the Corporation's design office which employs a large staff on modification and project work.

One of the causes of relative inefficiency, as the Jack Inquiry report explained, is the multiplication of unions; there are 17 different unions representing various sections of aviation workers within B.O.A.C., whereas none of the three other airlines has more than three trades unions with which to deal.

Loophole for Decca?

IN addition to the decision in favour of VOR/DMET outlined in last week's issue (pp. 274-275), the special ICAO navigation aids meeting at Montreal made one other major recommendation. This appears to provide a loophole by which Decca might be able to gain a position in the future.

The recommendation is to the effect that states which are in a position to do so should be encouraged to develop or continue development of systems based on the list of requirements prepared by the meeting.

Meanwhile, the recommendations of the meeting in favour of VOR/DMET still have a long road to travel. They will be considered first by the ICAO Air Navigation Commission of 12 specialists and then passed to the 73 member nations for comment. The Commission will then review the comments and make its decision, which will be considered by the 21-member Council—from which a two-thirds majority is required.

A U.K. Government statement and further comments appear on page 303.

Getting the Costs Down

A MUCH higher proportion of Britain's available research effort in aeronautics should be devoted to the further advancement of the subsonic aeroplane, which is the common carrier aeroplane now and for as far as can be seen ahead. This was the conclusion of Mr. N. E. Rowe, technical director of Blackburn and General Aircraft, in his Chadwick Memorial Lecture, "Factors in Air Transport Economics," given at Manchester on March 11.

The themes of this stimulating paper were that the largest single factor determining the rate of air-traffic growth was reduction in fares, and that short-stage operations were the most fruitful areas of transport aircraft application for engineers and scientists to concentrate upon.

Both these contentions were supported by closely reasoned arguments, which led to the conclusion that reduction in operating costs of the short-stage vehicle will offer the most widespread benefit and stimulus to air transport—assuming that it is passed to the consumer as a fare reduction (although "at the present moment the method of determining fare structures seems to offer little incentive to reduce costs"). Short-stage operations are "the realm of subsonic aeroplanes," suggesting that this speed bracket is a much more important one for research and development in this country than supersonic speeds. In the author's view, supersonic aeroplanes are unlikely to reduce the cost of air transport. They will of necessity be expensive to build, more difficult to maintain and particularly expensive in powerplant maintenance.

From a discussion of factors influencing transport aircraft efficiency Mr. Rowe showed that hourly cost/unit all-up weight, rather than direct operating cost, may be of particular significance for short-range aircraft, which spend a large proportion of their flying time at less than maximum economical potential. Hourly costs are made up of depreciation, interest and insurance (which all depend on the first cost); crew costs; fuel costs; engineering costs; and landing fees. Of these, the factors depending on first cost, plus the engineering and fuel costs, amount to more than 80% of the total and are, therefore, the items on which to concentrate.

As an example: an aircraft having a reduced first cost/ton of 20%, with simplified engineering and maintenance to save 20% in engineering costs and greater overall efficiency to save 20% of fuel cost, would be able to achieve a 16% reduction in hourly cost/unit all-up weight. It is not sufficient just to reduce these costs for a given air transport requirement—they must all be lower per ton of gross weight.

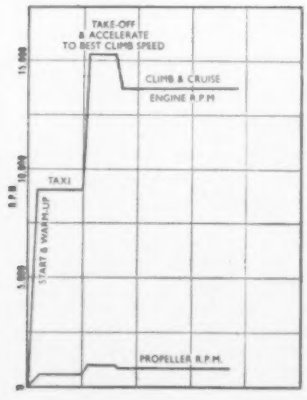
Ways in which improvements can be made in the three vital areas were then discussed by the author. Reductions in fuel costs can be achieved by improving the L/D, but a compromise is necessary here in order to increase cruising speed. Costs

(*Continued on page 303*)

OVERSEAS ELECTRA.—Below, on the right, is the first of two Lockheed Electras for Australia's Ansett/A.N.A. which is due to be delivered this month. In the picture directly below is the first of two Electras for Cathay Pacific Airways of Hong Kong; delivery is expected next month.

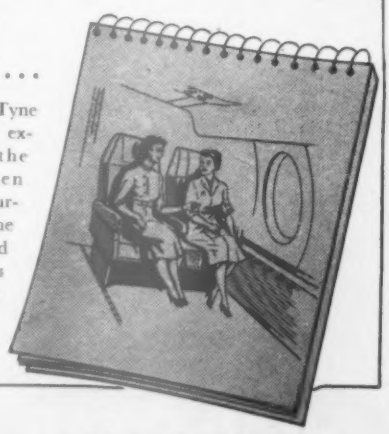
Yes, with the VANGUARD

The many problems of noise nuisance on and around airfields will be reduced by the introduction of the Vickers Vanguard. Noise from the four Rolls-Royce Tyne propeller-turbines is remarkably low for an aircraft of the Vanguard's size and power. This will be of particular advantage when operating from airfields in or near residential areas. A lower noise level on the airport will also increase efficiency in the administrative blocks and improve the broadcasting of passenger information. The lower interior noise and vibration will win approval from operators, pilots and passengers.



For your notebook...

Gases from the Tyne engines are only exhausted after the power has been absorbed by the turbine. This is one reason for reduced noise. The other is the low propeller tip speed.



VICKERS VANGUARD

FOUR ROLLS-ROYCE TYNE TURBO-PROP ENGINES

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY

TGA AT541

C

One-day remould exchange service

WORLD AIRLINES and charter companies benefit from the speedy aircraft tyre remould service available from the Goodyear depot at London Airport. Worn covers can normally be exchanged within twelve hours for top quality Goodyear factory remoulds which have a performance equal to new tyres. On-the-spot repairs and maintenance on tyres, wheels and brakes is also carried out, all work being supervised by a staff of A.R.B.-approved engineers. Take advantage of the Goodyear Aviation Service for safer, more economical operation.

The Goodyear Tyre & Rubber Co. (G.B.) Ltd., Aviation Products Division : 8-9, Salop Street, Wolverhampton. Tel. : Wolverhampton 27727. Airline Sales & Service, Viscount Way, London Airport, Hounslow, Middx. Tel : SKYport 1922 (5 lines).

GOODYEAR AVIATION DIVISION

SERVING AVIATION THE WORLD OVER

(*Continued from page 302*)

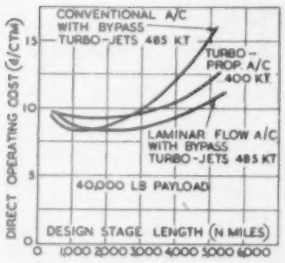
per hour increase, but the rate of doing transport work increases faster.

Fundamentally, in a short-range transport, the aim is to enclose and carry a specified payload together with the essentials for safety, comfort in flight and the fuel needed, in an aircraft having the minimum surface area exposed to the airstream, within limitations set by operational considerations such as balanced field length and climb away under adverse conditions, economic cruising, safety with engines out and so on. Little can be done in this context about body size; hence reduction of skin area for specified payload/range can be obtained only by reduction in aerodynamic surfaces and nacelles.

Two major lines of attack have been developed to improve maximum usable lift coefficients and hence to reduce wing and tail areas—the jet-flap, and boundary-layer control by blowing. The latter, in a military application, has roughly doubled the usable lift coefficient for landing and take-off, and has thus halved the wing area. No application of the jet-flap has yet been made and military experience is required before the first civil use. The same applies to the promotion of laminar flow by suction—which also could, potentially, reduce fuel costs by improving L/D.

Also affecting fuel cost/unit gross weight is the choice of powerplant. For short stages the turboprop currently has the advantage, but the by-pass or turbofan is extremely promising because of greatly increased thrust/weight ratios and improved economy. For example, the combined effects of increasing the t/w ratio from 5.3 to 7 and reducing the s.f.c. from 0.77 to 0.69 would improve the direct operating costs of a short-haul transport by 10%.

So far as first costs are concerned, the latest aircraft types, at about £6.5-£8.5/lb. all-up weight, are at least 50% costlier than the Viscount (at £5.5) and piston-engined aircraft of the last decade (at £4.8). The aircraft manufacturer has less and less control over the final aircraft cost because so much equipment is now bought out, but, in the interest of economy, complexity should be avoided and attention paid to choosing items in large-scale production—especially the engine.



Comparison of operating costs of laminar flow and conventional aircraft.

Engineering costs have two main aspects—design and operation. So far as the design aspect is concerned, wear and fatigue seem to be basic causes of trouble in airline engineering, resulting in unreliability and low component lives. Both may be caused by undue vibration—in which respect jet-engined aircraft may have a distinct advantage. Notable contributions to reliability can be made by using simple mechanical means of control and actuation—and designers should go and see for themselves the troubles encountered by airlines in the field.

In general, high L/D and cruising at great heights will both be factors leading to reduced engineering costs per hour—the one influencing engine loading and vibration in flight and the other resulting in a lower rate of gust incidence.

Aftermath to Montreal

THE Government's views on the Decca–VOR/DMET situation were given in the Commons on March 4 by Mr. John Hay, Joint Parliamentary Secretary to the Ministry of Transport and Civil Aviation, in a written reply to two questions.

He said that he endorsed the action of the U.K. delegation at Montreal in reserving the British position and withdrawing the Decca proposal in protest against the non-objective approach at this special COM/OPS/RAC meeting. "It is essential to the future of safe navigation in the air," the statement continued, "that ICAO should establish adequate technical criteria for defining navigational requirements, and that a detailed examination should then be made of the extent to which either of the two systems meets these requirements. Neither of these things has been done.

"Before VOR/DMET can be accepted as an international standard the recommendations of the special conference must be approved by a two-thirds majority of the Council of ICAO.

"Present standards of safety in congested air space cannot be maintained with the use of VOR/DMET without seriously reducing the efficiency of air traffic control. For this reason H.M. Government will continue to press in ICAO for a more satisfactory solution. In the meantime the further development and evaluation of the Mark 10 Decca system will continue.

"We are not aware on what grounds the International Air Transport Association decided to support VOR/DMET. Both B.O.A.C. and B.E.A. expressly and publicly dissociated themselves from this decision."

Obviously, if the situation does not change, if we believe the U.K. policy to be correct and if, later, we find that adequate air traffic control cannot effectively be maintained without the use of an area-coverage navigation system, we could insist that all aircraft using controlled airspace in the U.K. should be equipped with Decca. This, however, would be an extreme action which would be likely to have fairly uncomfortable results for our own operators elsewhere.

A much more effective and essentially reasonable policy would be that of giving priority to Decca-equipped aircraft during heavy traffic periods in the busier airways and control areas. Such a policy would permit a more rapid programming of movements without necessarily delaying other aircraft more than they would have been delayed when using normal aids.

Operational trials are, in fact, due to start in the U.K. on May 1 with the use of a climb-out airway (a sector of Amber One) for use only by Decca-equipped aircraft. These trials, which will last for six months, are designed to provide information—in addition to that being gained from the use of Decca track procedures now operating within and in the approaches to the London Terminal Control Area—which can be used as a basis for permanent provision of unrestricted climb-out paths for Decca-equipped turbojet and turboprop aircraft.

Resisting the Increases

OBJECTIONS are inevitably being made to the new scale of landing fees, which is due to come into force on April 1, and to the proposed increase in the passenger-service charge from 5s. to 7s. 6d.

The half-crown increase in the so-called service charge is not a particularly serious matter—and certainly not to the long-haul operators—but it is an irritating addition to the cost of air travel for those who are flying short distances. The collecting of the charge, which is normally done by the airlines, also increases the work-load for the short-haul operator. B.E.A. has protested to the M.T.C.A. about the increase.

Details of the landing-fee increases (see THE AEROPLANE of February 20, p. 212) have not yet been issued—though the proposals have, no doubt, been circulated among airline operators—but they are substantial enough to yield an additional £660,000 per annum—an increase of about 28% at present movement-rates. B.E.A. was due to discuss them with the Ministry on March 11 and the Foreign Airlines Association (representing 38 overseas operators) will meet Ministry officials on March 20.

The situation is obviously a difficult one for the airlines, who have made their fare and rate arrangements for the coming season. Estimates of the costs of the new charges vary between about £150,000 per annum each for B.E.A. and B.O.A.C. to about £12,000 for Sabena.

Nevertheless, it is obvious that pressure is being put on the M.T.C.A. to reduce the costs to the taxpayer of the U.K. airports. In the Comptroller and Auditor General's report on the Civil Appropriation Accounts (published on March 3) it was stated that the 24 airports under the control of the Ministry showed an estimated net cost in 1957-58 of £5,308,400. Expenditure (including a figure of £4,237,270 for depreciation, interest and administration) was £9,513,319 and revenue was £4,204,919. The revenue included a figure of £2,247,000 from landing fees and passenger-service charges. London Airport's share of the deficiency was £2,281,167.

D

The Supersonic Transport—Airline Views

Six airline engineers, American and European, contributed their views on supersonic transports following presentation of papers by Boeing, Convair and Douglas at the I.A.S. Annual Meeting in January.

THAT there will be, in the not-too-distant future, a supersonic transport in regular airline service now seems certain. Its characteristics, however, are as yet much less certain and, in particular, the best cruising speed has still to be established. In their papers before the Institute of the Aeronautical Sciences (see THE AEROPLANE for February 13, 1959), Boeing, Convair and Douglas engineers all gave it as their view that the first-generation supersonic transport would be in or about the Mach-3 bracket; the time advantage to be gained by going for Mach 1.5 or 2 was small, and in any case the airlines would not be ready for another major financing programme until about 1970.

On the other hand, the British Supersonic Transport Aircraft Committee has been tending to the view, we understand, that Mach 1.4 or 1.8 is fast enough to start with. This would be a much more modest undertaking than the 500,000-600,000 lb. projects envisaged by Convair and Douglas, and would be ready sooner—but might not find a large market.

Until the I.A.S. meeting, little had been heard of the views of the operators themselves, so written contributions by senior engineers of American Airlines, P.A.A., T.W.A., United, Swissair and S.A.S. to the discussion were hardly of less interest than the papers themselves. In the next 10 years, the airlines will undoubtedly be under great pressure from the industry to accept a supersonic transport and this, coupled with the pressure of competitive buying, may lead to considerable modification of the views expressed today. At the present time, however, it seems clear that the majority of airlines agree that they should wait for Mach 3 and cannot quickly afford major capital expenditure on a supersonic transport—" most of the airlines that are committed to finance huge new fleets of subsonic jets would rather prefer to start a Mach 3 jet operation after 1972 instead of being pushed into a Mach 1.5 in 1965."

The airline speakers questioned one or two of the technical features suggested by the industry, and wanted more information about powerplants and advanced system concepts hinted at but not fully explained. There was a broad measure of agreement that the supersonic transport will be designed from the outset for ranges of 3,500 miles or more; should have about the same passenger capacity as the present subsonic turbojets; will cruise at 60,000 ft. or more and *must* have absolute pressure-cabin integrity.

As one would expect, the airline engineer is much concerned with the economy of operation. Although there were differences of opinion over the actual utilizations which could be achieved, most contributors agreed that it would be less than with the subsonic jets: comparatively short journey times will make supersonic operations not unlike present-day short-haul operations, with high percentages of ground time. The operating costs, therefore, seemed likely to be higher than suggested by the industry speakers.

Other specific points made by the airline contributors were as follow:—

R. W. Rummel, vice-president, engineering, T.W.A.

It appears doubtful that manufacturers in this competitive age could afford to trade Mach 2 development time for Mach 5 development time, since the risk of being shortly surpassed would be too great. Not more than two years' difference exists in time required for developing Mach 2 and Mach 5 transports.

Pressure envelope redundancy in the fuselage might be provided, with an inner shell that can never leak and an outer shell, carrying the pressure load, which also never can leak.

A design should be sought which permits reasonable flexibility of use and " downgrading " on introduction of still better (hypersonic?) transports.

Birger Holmer, director, project and development engineering, S.A.S.

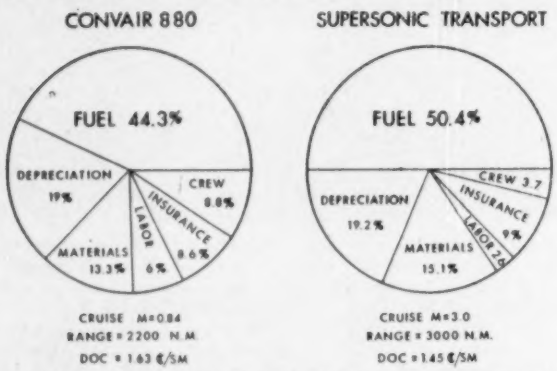
A good estimate of the weight of a transoceanic supersonic jet with 3,500 naut. mile range is about 500,000 lb.

In the past, the price of aircraft has increased almost linearly in proportion to productive capacity. The cost of the supersonic transport can be estimated at roughly $20 million.

On a typical U.S.-Europe route, possible theoretical utilization of the supersonic transport is 8 hr. a day, compared with 16 hr. a day for a subsonic jet. Scheduling of east-bound trips is a particular problem because of time differentials.

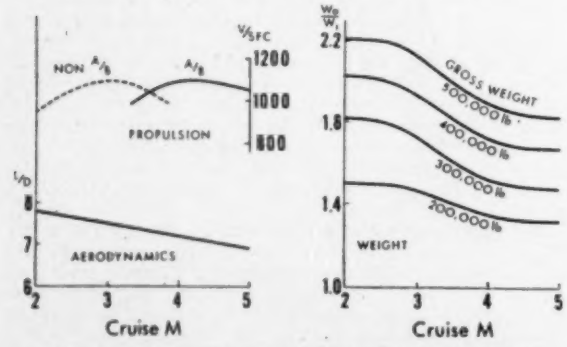
Runways required for the subsonic jets on transoceanic trips will be long enough for the supersonic jets.

Use of water-cooling for aerodynamic heating would offer great

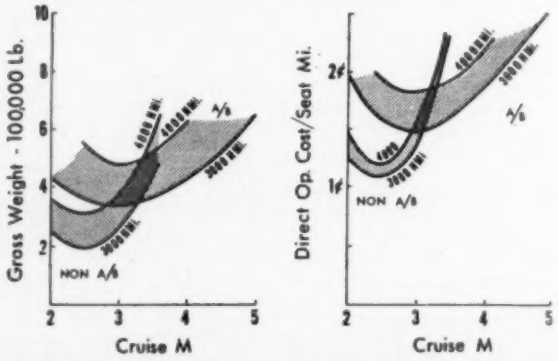


A Convair comparison of direct operating cost breakdowns for the Convair 880 and a Mach-3 transport, based on ATA costing techniques, 100% load factors, 3,000-hr. utilization and 10-year depreciation.

$$\text{RANGE} = \frac{V}{SFC} \times \frac{L}{D} \times \text{LOG}\left(\frac{W_0}{W_1}\right) - 500 \text{ N.Mi.}$$



Supersonic range parameters, showing (left) that neither the aerodynamic parameter (L/D) nor the propulsion parameter vary extensively with Mach number. The right-hand diagram shows the estimated ratio of fuelled weight to empty weight for various gross weights and cruising speeds.



Weights and direct operating costs plotted for different cruising speeds and ranges, with and without after-burning engines. In general, the smallest aeroplane to do the job will carry the least fuel and have the lowest cost.

difficulties at ground level at subsonic speed when operating through arctic and sub-arctic temperatures.

Sanford B. Kauffman, assist. vice-president, engineering, P.A.A.

Our entire experience in aircraft operation has shown that you cannot rely entirely on electronic and mechanical devices regardless of how attractive they may appear on paper.

The supersonic transport must have flight characteristics which are equal to or better than present subsonic jets.

The traffic control problem will probably be the most difficult one to resolve. Flight crews today are confronted with too many contact points, too many frequencies, too much cockpit paper work and too much blocked airspace on practically every flight.

The sonic boom may well prove to be one of the most, if not the most, troublesome problems in supersonic aircraft operations.

Fleet utilization of 7½ hr. a day (suggested in the Boeing paper for a New York—Paris schedule) appears somewhat optimistic.

M. G. Beard, assistant vice-president, equipment research, American Airlines

Ground time in the block-to-block schedule time might be reduced from about 12 minutes now to 6-8 minutes even at the larger airports.

A supersonic jet transport will require a fuel load larger in proportion to the theoretical minimum required for the flight than does the subsonic jet; this will be one of the determining factors of the fare to be charged which will in turn determine the degree of public use.

It will be necessary to use kerosene or JP-5-type fuel to avoid the penalty of evaporation losses.

Cabin differential should provide 6,000 ft. equivalent at cruising altitude (rather than 8,000 ft. as suggested by Boeing); this would have a slight economic advantage in reducing descent times.

Progressive maintenance may mean the aircraft will never need a complete overhaul, but to maintain a reliable schedule at least one spare aeroplane may be needed for a fleet of only four.

A. O. Baltensweiler, vice-president, planning and project engineering, Swissair

Anticipated passenger potential in 1970 of a typical medium-size airline flying on North Atlantic, South Atlantic and Far East routes could be met by 32 DC-7Cs at 14 hr. a day; 11 DC-8s at 12 hr. a day or five Mach 3 jets at 8 hr. a day.

Pooling of technical resources between airlines will become more than ever necessary to take care of several small fleets of different types, and the need for a high percentage of spare aircraft will force the airlines to form aircraft pools.

Potential utilization will be reduced by timing difficulties, unless fare differentials are used to boost night flying.

As shorter trip times favour higher frequencies, size of the Mach 3 jet should be kept close to that of the present subsonic jets.

Ray D. Kelly, Supt., technical development, United Air Lines

Mach 3 aircraft will face great difficulties in achieving practical application to civil air transportation needs. The Mach 2 aeroplane seems to offer less departure, operationally and structurally, from the conventional. A Mach 2 civil powerplant may be within the realm of early practicability.

The Mach 2 aeroplane may show lower proportionate fuel costs than the 60-70% of direct operating cost depicted (in the Douglas paper) for the Mach 3 transport.

It is doubtful if a 15-minute fuel reserve (suggested by Douglas) will be accepted by airline operating managements for some time to come.

The McDonnell 119

ILLUSTRATED in THE AEROPLANE for February 13 (page 180) the McDonnell 119 has recently begun its flight trials. Designed and built to meet the U.S.A.F. requirement for a medium-weight, multi-engined jet utility transport/trainer, the McDonnell 119 is also to be offered as an executive and business transport. Produced as a private venture at a cost of over $10 million, it competes directly with the Lockheed JetStar, which began its flight trials on September 4, 1957 (see THE AEROPLANE for January 16, 1959). No military orders for a UCX type have yet been announced, but Lockheed have already decided to go ahead with production of the JetStar.

McDonnell have chosen a conventional four-podded engine layout for their Model 119, chosen after evaluation of 34 different possible layouts. Engineering design is in keeping with contemporary practice, the structure being based on the use of fatigue-resistant materials in conjunction with crack-stopping, fail-safe design. Three integral fuel tanks are contained in the wing torsion box, with a fourth bay for flexible tanks aft of the rear spar in the centre section.

Flight controls are manually operated, except for the hydraulic spoilers which supplement low-speed ailerons at the wing tips. All primary control surfaces have balance tabs. Multi-segment plain flaps are used on the wing and across the centre section under the fuselage.

A 3,000 p.s.i. hydraulic system operates the undercarriage, flaps, brakes and spoilers. Primary electric power is DC, with AC available through inverters, but an AC system may be installed for special future roles. Boot-type de-icers are used on the wing and tailplane, with bleed-air de-icing for the engine intakes. A blow-away jet is provided to prevent ingestion of foreign objects by the engines.

Seat tracks are provided in the fuselage floor for maximum flexibility of interior arrangements, which range from 10

passengers plus toilet and galley, to 26 troops, 12 stretchers, 8,700 lb. of freight or a variety of military training lay-outs.

For its preliminary flight trials the McDonnell 119 is powered by four Westinghouse J34 turbojets, de-rated to about 3,000 lb. s.t. each. Like Lockheed and North American with their UCX and UTX designs, McDonnell have been embarrassed by the non-availability of suitable small turbojets, and they now plan to use the 3,000 lb. s.t. Pratt & Whitney JT-12 in production models, rather than the Fairchild J83 (now abandoned) or General Electric J85 originally planned. Data which follow are for the military version with JT-12 engines:

DIMENSIONS.—Span, 57 ft. 7.2 in.; overall length, 66 ft. 5.9 in.; overall height, 23 ft. 7.7 in.; gross wing area, 550 sq. ft.; sweepback, 35 deg. at 25% chord; fuselage diameter, 89 in.; internal cabin height, 74 in.

WEIGHTS.—Max. take-off, normal range, 40,928 lb.; max. take-off, full internal fuel (eight passengers) 45,238 lb.

PERFORMANCE.—Cruising speed for max. range, 453 knots (M=0.79); landing speed (1.1 Vso) 93.6 knots; critical field length (40,928 lb.) 4,135 ft.; landing ground roll (half-fuel) 1,920 ft.; still air range (with civil SR.427 reserves, 200-mile alternate), 1,825 naut. miles.

A Matter of History

ILLUSTRATED alongside is the cowling developed for the Bristol Britannia some two years ago at the R.A.E., in which the customary annular air intake was replaced by a series of eight flush intakes of the N.A.C.A. type, feeding air straight into the duct "elbow." This arrangement was one of several experimental solutions to the Britannia's icing-up troubles, and a cowling of this type was fitted to the prototype G-ALBO for one of the last proving flights to Singapore. It proved extremely satisfactory so far as icing was concerned, but the intakes scooped away the boundary layer air so that vortices were induced on the wing behind the nacelle with an increase in drag leading to a range penalty of some 4%.

The Fighting Services

Inspector-General of the R.A.F.

AIR MARSHAL SIR JOHN R. WHITLEY, K.B.E., C.B., D.S.O., A.F.C., is to become Inspector-General of the R.A.F. in June in succession to Air Marshal Sir Gilbert E. Nicholetts, K.B.E., C.B., A.F.C., who is retiring from the Service. Air Member for Personnel since January, 1957, Air Marshal Sir John Whitley was previously Air Officer Commanding, No. 1 Group, Bomber Command, for more than three years.

Air Marshal Sir John Whitley

Before becoming Inspector-General in January, 1958, Air Marshal Sir Gilbert Nicholetts was Air Officer Commanding, Malta. He entered the R.A.F. College, Cranwell, in 1921 and in 1933 was co-pilot of the Fairey monoplane which established a World long distance record by flying 5,309 miles non-stop from Cranwell to Walvis Bay, South-West Africa.

Standard Presentation

HER Majesty Queen Elizabeth the Queen Mother will present the Standard to No. 617 Squadron at R.A.F. Scampton on May 14. The Squadron extends to all former members a cordial invitation to attend the ceremony. Those wishing to do so should contact as soon as possible the Adjutant, No. 617 Squadron, R.A.F. Scampton, Lincs.

Fleet Air Arm Promotion

REAR ADMIRAL C. L. G. EVANS, C.B., C.B.E., D.S.O., D.S.C., who became Flag Officer Aircraft Carriers in January of this year, has been promoted to the rank of Vice-Admiral. Appointed Captain (Training) on the Staff of the Flag Office Air (Home) in 1948, he later became Director of Naval Air Warfare at the Admiralty and then commanded the carrier "Ocean." Before Admiral Evans was promoted to Flag rank in January, 1956, he was Commodore of the R.N. Barracks, Portsmouth. In February, 1956, he was appointed Flag Officer Flying Training and in October, 1957, he became Deputy Chief of Naval Personnel (Officers).

Cyprus Honours

IN the London Gazette for March 3 the following are included in a list of awards to R.A.F. and Commonwealth Air Force personnel for recognition of service in Cyprus:—

Order of the British Empire (Military Division)

As Companions: Wg. Cdr. J. B. Evans, Wg. Cdr. H. M. Shephard.

As Members: Sqn. Ldr. N. Burton, Flt. Lt. R. B. Truscott.

Air Force Cross

Flt. Lt. J. O'Hara.

British Empire Medal (Military)

Sgt. A. E. Stafford, Sgt. D. Thompson, Ch. Tech. T. H. Charleston.

R.A.F. Appointments

THE following are among recent Royal Air Force appointments:—

Air Ministry: Wg. Cdr. B. Morgan, M.B.E., for duty in the Department of the Air Member for Personnel.

Fighter Command: Wg. Cdr. K. B. S. Willder, O.B.E., to Headquarters as Gp. Capt. Electronics (2) (with acting rank of Gp. Capt.); Wg. Cdr. F. N. Brinsden to R.A.F. West Malling to command the Administrative Wing.

Technical Training Command: Wg. Cdr. K. E. Christensen to No. 2 School of Technical Training, Cosford, to command the Technical Wing; Wg. Cdr. M. E. Claxton to No. 2 Radio School, Yatesbury, for education duties; Wg. Cdr. A. W. Jones to the R.A.F. Technical College, Henlow, for accounts duties; Wg. Cdr. C. E. P. Suttle to No. 1 Radio School, Locking, as Senior Education Officer; Wg. Cdr. W. C. Vaughan to Headquarters for training duties.

Maintenance Command: Wg. Cdr. H. H. Mayoh to Headquarters as Command Education Officer (with acting rank of Gp. Capt.).

Home Command: Wg. Cdr. E. V. Masters, M.B.E., to the R.A.F. Record Office, Gloucester.

R.A.F. Germany (2nd. T.A.F.): Wg. Cdr. E. A. Grant to R.A.F. Laarbruch to command the Administrative Wing; Sqn. Ldr. P. H. Cleaver, D.F.C., A.F.C., to R.A.F. Jever to command the Administrative Wing (with acting rank of Wg. Cdr.); Sqn. Ldr. E. W. F. Hare to R.A.F. Geilenkirchen to command the Administrative Wing (with acting rank of Wg. Cdr.).

Middle East Air Force: Wg. Cdr. W. H. McCulloch to Headquarters for Provost duties.

Headquarters, British Forces Arabian Peninsula: Sqn. Ldr. J. J. Deverill as Chief Intelligence Officer (with acting rank of Wg. Cdr.).

Auxiliary Trophy Award

COMMANDED by Sqn. Ldr. J. C. Robertson, No. 3612 (County of Aberdeen) Fighter Control Unit, R.Aux.A.F., has won the 1958 Fighter Control and Radar Reporting Efficiency Trophy, as the most efficient F.C.U. in No. 13 Group, Fighter Command. Runner-up was No. 3502 (Ulster) F.C.U., Belfast (Sqn. Ldr. H. T. Cathcart) of the same Group.

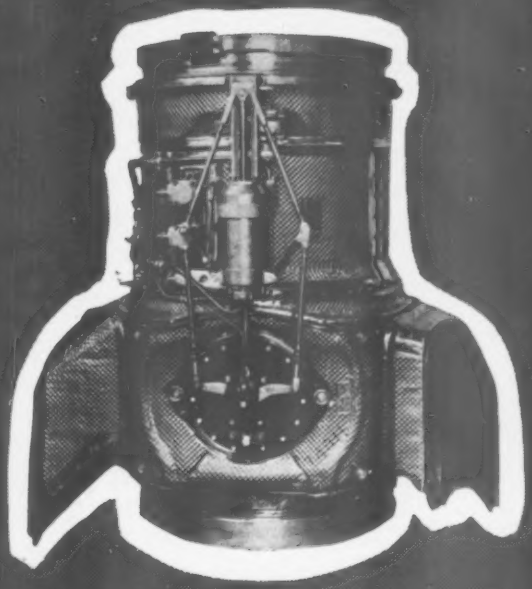
Reunions

No. 256 Squadron.—A reunion dinner will be held at the R.A.F. Club, Piccadilly, London, W.1, on April 17. Applications for tickets (price 30s. each) from former Squadron members would be most welcome and should be sent to 256 Reunion, 149 Mortlake Road, Richmond, Surrey.

No. 2 Squadron.—The 1959 reunion will be held in London on April 10. Details and tickets (price 25s. each) can be obtained from Sqn. Ldr. C. S. MacDonald, R.A.F. Selection Board, Cranwell, Sleaford, Lincs.

Central Flying School.—The annual reunion dinner of the C.F.S. Association is to be held in the Officers' Mess, R.A.F. Little Rissington, on July 10. Full particulars will be circulated to all members in due course by the honorary secretary.

OLD INSIGNIA REVIVED.—After a lapse of 14 years No. 81 Squadron has reintroduced its distinctive marking for its aircraft which was originally borrowed from a leading German fighter group in 1943. At present commanded by Sqn. Ldr. R. J. Linford, seen by his aircraft, and based at R.A.F. Tengah, Singapore, the Squadron's Meteor P.R.10s now carry the "ace of spades" on their noses. This marking was last used by No. 81 on its Thunderbolts in 1945.



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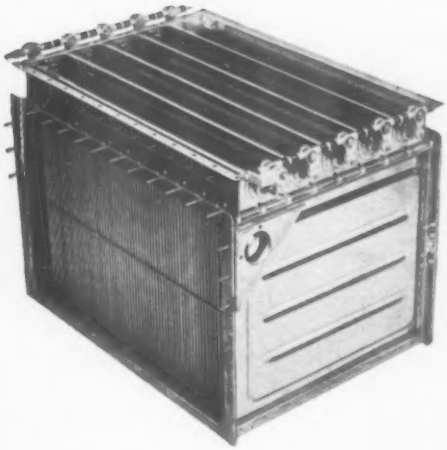
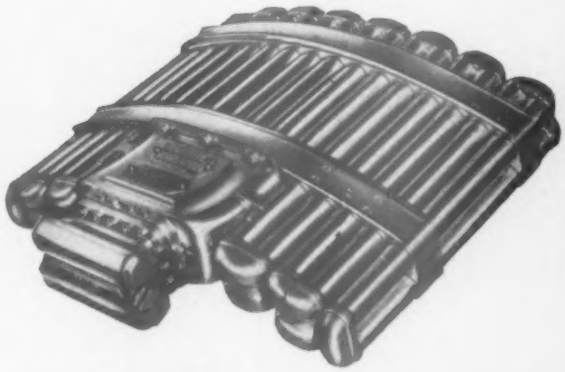
High pressure fuel-cooled oil coolers for high performance gas turbine engines. This unit is used in the Armstrong Siddeley Sapphire S.A.7.



Heat exchangers for many purposes in both aluminium alloy and stainless steel. This particular example is for the Vickers Vanguard's anti-icing system. Similar units are being supplied for the Fokker Friendship, the Bristol Britannia, the Armstrong Whitworth Argosy, the Vickers Viscount and the Handley Page Herald.



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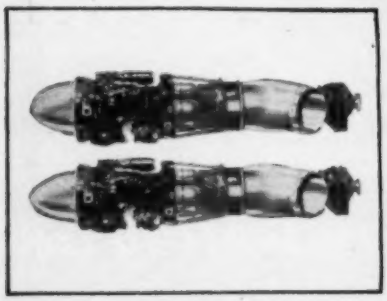

Napier Elands power the Westland Westminster

The impressive performance of the Westland Westminster, seen for the first time at Farnborough 1958, is a tribute to the power of its Eland turbine engines.

The Military Crane version of the helicopter provides a transport of the first importance for the tactical movement of field equipment, atomic missiles and commando troops.

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CEC E40

Report on Japan's Aircraft Industry—2

by John Fricker

The Japanese Maritime Self-Defence Force has received 16 Lockheed P2V-7 Neptunes under U.S. mutual aid agreements. This type is also being built by the Kawasaki company, and the first is due for delivery in October.

CONTINUING the Kawasaki story, mention must now be made of the helicopter activities of this company, which began in November, 1953, at Kobe, with the production of the Bell 47D, following an agreement in January of that year with the American company. Since that date about 80 Bell 47s of the D, G and G-2 series have been completed in Japan with American Lycoming engines, for the GSDF (20), MSDF (18), Burmese Air Force (13), Brazilian Navy (2), Japanese Coast Guard Service (1), and various civil customers, including whaling, newspaper and electric companies. The Japanese Antarctic expedition is also using two Kawasaki-Bell 47Gs, of which the number in the GSDF will be doubled in the forthcoming year.

Extensive work was also completed on an original helicopter design to compete with the Sikorsky S-58, which was, however, selected as the standard anti-submarine helicopter for the MSDF. Two of these rotorcraft were received from the U.S. by the Maritime Self-Defence Force in mid-1958, and it is estimated that about 60 anti-submarine helicopters will be required to equip three squadrons. The nucleus of the first S-58 (HSS) squadron is due to be formed with eight rotorcraft.

The Kawasaki KAHX-1 project is therefore unlikely to be developed, but for the record, it was of Sikorsky-type layout with three-bladed main and tail rotors driven by a 960-g.h.p. Lycoming T53 free-turbine engine. This was to have been mounted above the fuselage to the rear of the rotor mast, and provision was made for alternative installation of the G.E. T58. With a capacity of 10-12 passengers and a crew of two, the T53-powered project was to have had an empty weight of 4,050 lb., a payload of 2,950 lb., and a maximum gross weight of 7,500 lb.

An unusual feature for a helicopter of its size was the use of a skid landing gear. At a cruising power rating of 650 g.h.p., the KAHX-1 was estimated to fly at 120 m.p.h. while the maximum speed was 135 m.p.h. Initial climb was computed as 1,800 ft./min., and the maximum ceiling 14,000 ft. Hovering ceiling out of ground effect was 9,500 ft., and the range 360 miles.

In the fixed-wing field, the major pre-occupation of Kawasaki at the moment is with the licensed production of the Lockheed P2V-7 Neptune anti-submarine aircraft for the MSDF. The four-engined (two piston, two jet) Neptune is the largest aircraft yet handled by the Japanese industry, and was therefore originally to be built by the Shin Meiwa company, who as the former Kawanishi organization had produced many large multi-engined flying-boats during the War.

Because of its existing contacts with Lockheeds, however, Kawasaki was nominated as prime contractor by the Japanese Ministry of International Trade and Industry last December, with Shin Meiwa as principal sub-contractor. The MSDF had previously received 16 P2V-7s from the U.S. to equip a maritime-reconnaissance squadron, and the scheme for Japanese production requires the completion of a further 42 Neptunes by 1962. These are to be built at the fairly leisurely rate of one per month, the first delivery being due in October, this year.

Tooling up and initial production are well advanced, although the first 14 aircraft are being assembled from imported components. The Wright R3350 radial engines and Westinghouse J34 turbojets for the Neptunes will all be imported, together with such items as the APS radar and other electronic and specialized equipment. Japanese expenditure on the airframe will therefore divide the costs of the order almost equally between the two countries, although the U.S. is paying 90% of the first six aircraft.

The remaining activities of Kawasaki include the production of the KAQ Radioplane-type target aircraft, powered by a small piston engine, and some research into aircraft powerplants and missiles. In August, 1954, prototypes of the 240-b.h.p. KAE piston engine for light aircraft or helicopters were completed, and underwent type testing during the following year. Official certification by the Transport Ministry followed on July 11, 1956, and production planning was put in hand at Kobe.

Engine development programmes also include research into ramjet, turbojet and rocket powerplants, while Kawasaki has, in addition, an interest in missile production. An early stage of experiment has been reached with a wire-guided anti-tank missile, on the lines of the French SS10, for the GSDF.

Nippon Hikoki K.K. (Japan Aircraft Manufacturing Co., Ltd.) One of the smaller Japanese companies, Nippon Hikoki was re-established in May, 1949, and subsequently undertook the repair and overhaul of U.S. naval aircraft, which is still its main business. It operates at present from three main plants, located at Sugita, Yokohama; Atsugi naval base; and Tachikawa. At the first two, the aircraft types handled in the past few years have included the Chance Vought F4U, F8U, Douglas AD, F3D, JD-1, Grumman AF, F9F, S2F, UF, TBM-3W, Hiller HTL, Lockheed P2V, McDonnell F2H and North American AJ, SNJ and FJ series. The Tachikawa plant has been mainly concerned with F-86Fs and F-86Ds of the U.S.A.F. and JSDF.

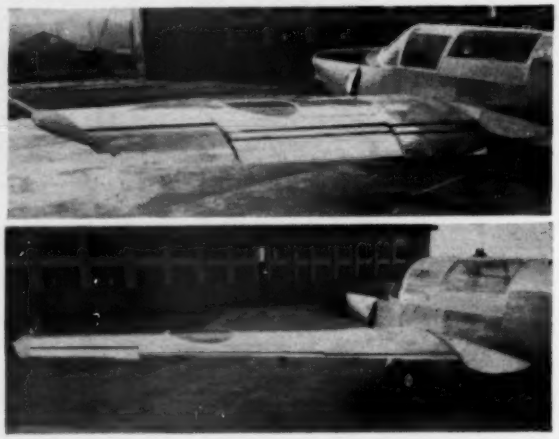
At Sugita are now produced a variety of components, jigs and tools on a sub-contracting basis for the Japanese-built T-33, F-86 and T1F2, together with such items as the mock-up for the YS-11 joint transport project. Sugita, on the shores of Tokyo Bay, is a former seaplane base of the Imperial Japanese

Navy, where in World War II a variety of aircraft were produced. They include 1,081 seaplanes (901 primary trainers, 86 Zuiun reconnaissance monoplanes, 90 bombers and four transports), plus 2,343 landplanes (2,322 trainers, nine 11-seat gliders, two amphibians and 10 Shusei rocket-powered fighters). The last-mentioned were based on the German Me 163, but only one was completed with rocket unit installed.

Excellent production facilities still exist, as a result of the reconstruction made possible by U.S. Navy business, but little work of an independent nature is undertaken by Nippon Hikoki. One interesting project, however, for which the company has been responsible, on behalf of the Technical Research Institute of the Japanese Defence Agency, is practical research into variable-area wings, for high maximum lift coefficients at low speeds, and the minimum cruising drag.

For these experiments special wings were to be installed on an existing light aeroplane. To avoid complication, a type was required with fuselage installation or stowage of the undercarriage, and a Saab-91B Safir fortuitously presented itself at just the right time. Its wings were therefore replaced, in 1957, with mainplane units of generally similar dimensions, but incorporating almost full-span slotted flaps, and spoilers for lateral control.

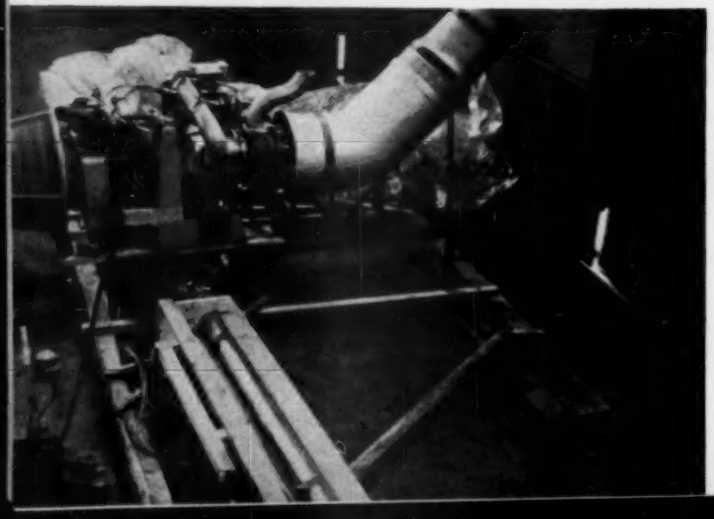
The flaps were of unusual design and were split into two segments on each wing, being double slotted and provided with rails for extension aft to increase the effective wing area by a substantial amount. Four positions could be selected.



Two views of the double-slotted flaps of the X1G1 in the fully extended and fully retracted positions. The ailerons also droop when the flaps are lowered, lateral control being augmented by spoilers.

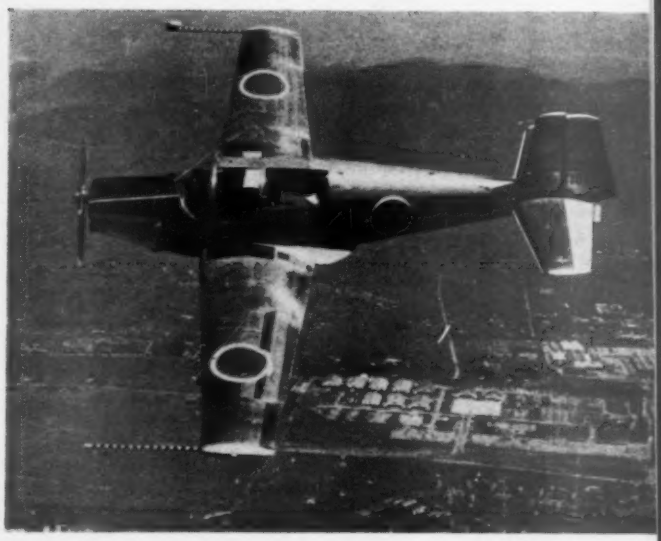
When fully stowed the flaps retracted within the trailing-edge line of the tip-ailerons, so that the wing area for cruising became about 90% of the figure for the "standard" position. The flaps were then not deflected but conformed to the original wing plan, the remaining two positions being 15° and 45° extension (35° for the outer sections). At their biggest deflection, the new flaps increased the C_L maximum of the Safir to 2.7, with a corresponding decrease in the minimum flying speed.

Flight tests of the X1G1, which was the Japanese designation of the modified Safir, began on December 23, 1957, and confirmed the effectiveness of the flap arrangement and control system. The tip-ailerons were used for only 5° deflection before being supplemented by the wing spoilers. Manœuvrability at all speeds was apparently good, and the speed range was widened at both ends of the scale.



In test-rig form before installation in the X1G2, this Continental Palouste air compressor is seen with a section of blown single-slotted flap which will be fitted to raise the C_L max. to 3.5.

Photograph copyright "The Aeroplane"



Modified from a Saab-91B Safir, the X1G1 has a new high-lift wing and lateral control system, and a slotted tailplane.

For lower-speed stability and control, the tailplane and elevator area of the X1G1 was increased by about 30% compared with the Safir. Slats were also fitted under the leading edges of the tailplane, as in the Prestwick Pioneer, to prevent airflow breakaway at very low speeds, and special fillets of distinctive shape and size were designed for the wing-fuselage intersections to reduce buffet resulting from flap extension.

Detailed figures assessed from flight tests are reproduced below, but the modifications may be summarized as having reduced the take-off and landing runs by very nearly 50%; slightly increased the maximum and cruising speeds; and considerably reduced the stalling speeds. The weight penalty of the electrically operated flaps, and manual aileron-spoiler linkage was naturally fairly substantial in so small an aircraft as the Safir, but would be proportionately much less, for example, for such a type as the YS-11 transport, which has a particular requirement for a good low-speed performance.

Following the successful conclusion of the first phase of flight trials with the X1G1, the Technical Research Institute is continuing with the next development, which is the addition of flap blowing. High-pressure air for this purpose is being provided by a Continental-built Palouste gas turbine, which is being installed in place of the rear seat of the X1G1, with its air intake in the roof of the cabin and exhausting through a nozzle above the starboard rear fuselage.

Bleed air from the compressor will be ducted to the inner sections of the flaps, which will be of the single-slotted type, and will be expelled through small holes in the leading edges at almost sonic speed. Similar ducting is to blow air from the leading edge of the wing over the upper surfaces, and the resultant increase in laminar flow over the cambered aerofoil is expected to increase the C_L maximum from 2.7 to 3.5.

Weight of the Palouste installation in the X1G2 will be about 330 lb., while an additional tank for the J.P.4 fuel supply in the port wing root will supplement the normal petrol tank in the other wing. To look after the gross weight increase to 3,086 lb. the X1G2 will be fitted with a 270-b.h.p. Continental in place of the earlier 190-b.h.p. Lycoming O-435A flat-six engine, but the effect of supercirculation is nevertheless expected to result in a slight decrease in minimum speed, to 46.6 m.p.h.

Apart from these modifications, and the replacement of the fabric-covered rudder by a metal-clad type, the X1G2 will be unchanged from the earlier experimental type. On completion, it will return to the T.R.I. experimental squadron at Gifu and join the Vampire Trainer, North American T-28B, T-34 Mentor, F-86F Sabre, T-6 Texan, and the two Fuji T1F2s of the unit, for further flight trials.

Comparative figures for the Safir and X1G1 (in parentheses) are:—

DIMENSIONS.—Span, 34 ft. 9 in. (35 ft. 4 in.); length, 26 ft.; height, 7 ft. 3 in.; wing area, 146.3 sq. ft. (157.1 sq. ft. in "standard" position).

WEIGHTS.—Normal operating, with two occupants, 2,320 lb. (2,534 lb.).

PERFORMANCE.—Max. speed, 171 m.p.h. (172 m.p.h.); cruising speed, 144 m.p.h. (131.6 m.p.h.); service ceiling, 20,500 ft. (19,352 ft.); landing speed, 66 m.p.h. (47 m.p.h.); take-off run, to 50 ft., 1,640 ft. (967 ft.); landing run, 1,968 ft. (984 ft.).)

Shin Meiwa Industry Co., Ltd.—As the former Kawanishi Aircraft Company, Shin Meiwa has a number of links with the British aircraft industry dating from pre-War days when many of its engineers were attached to Short Bros. to learn flying-boat design and engineering. How well they learnt was illustrated by the subsequent large-scale production of multi-engined flying-boats by Kawanishi, including the H6K1 "Mavis" and the H8K2 "Emily." The latter, designed by Mr. Kikuhara, who was also responsible for the N1K1 "George" fighter, and is still chief designer of Shin Meiwa, owed much in its basic conception to the Sunderland, but had a hull of advanced hydrodynamic design.

Kawanishi turned out 168 "Emily" flying-boats between 1942 and 1945, while wartime production (from 1940 onwards) also included a number of E7K1 sea-reconnaissance aircraft; nearly 200 H6K1 "Mavis" flying-boats; 15 E15K1 "Norm" floatplanes; 97 N1K1 "Rex" fighters; 1,007 N1K1J and 400 N1K2J "George" fighters; and 96 P1Y2-S "Francis" medium bombers. On V-J Day Kawanishi had a production floor area of nearly 6 million sq. ft., and some 77,400 employees.

After the War these facilities were converted to civilian industries until in 1949 Shin Meiwa was established to manufacture and repair aircraft, aero-engines, components and accessories. In 1950 the former flying-boat factory at Konan, between Kobe and Osaka was reopened for the manufacture of spares for the U.S.A.F. and, following agreement with the D.H. Engine Company in the U.K., and some American engine companies, powerplant overhauls began in 1954 at Naruo.

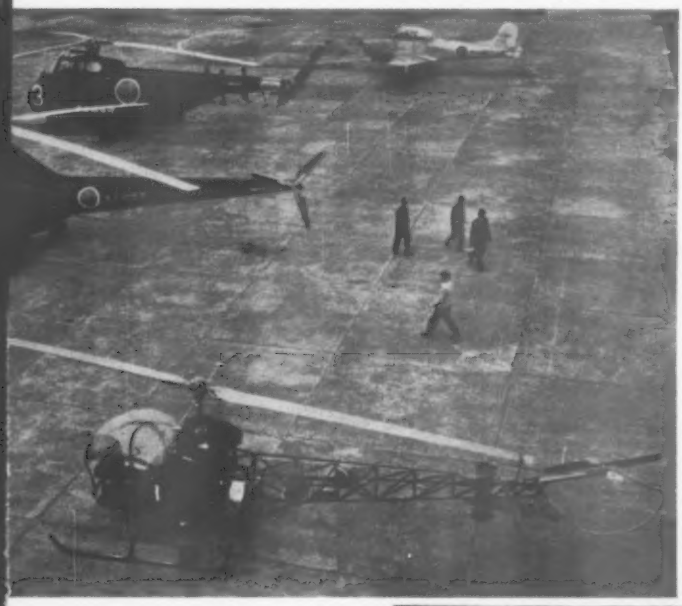
This was also near Osaka, where in 1955 the Itami factory of Shin Meiwa was reopened, principally for the overhaul of U.S. and Japanese naval aircraft, plus a few commercial types. Aircraft handled there have since included Douglas R5D-3s, Fairchild R4Q-1s, Douglas R4D-8s, Martin PBM-5As, Beech SNB-5s and JRB-4s, Vertol HUP-2s, Douglas A3D-1Qs, Cessna OE-1s, Sikorsky HUS-1s and Grumman TF-1s of the U.S. Navy, while from the U.S.A.F. have been overhauled Douglas C-47s and Vertol H-21Bs and Cs.

The JMSDF have added Lockheed PV-2s, Westland-Sikorsky S.51s, Grumman TBMs and Lockheed P2V-7s, while at Konan its flying-boats have included Convair PBYs and Grumman JRFs. Itami has also seen in for overhaul C-46s of the JASDF and a variety of commercial aircraft including Doves, Herons and Marathons, bringing the grand total of aircraft handled by January, 1959, at Shin Meiwa to 272. As agents for some British overhauls, the company has also dealt with Gipsy Queen, Leonides and Cirrus engines, in addition to American Wasp R985s, Twin Wasp R1830s, Lycoming O-290s and Continental R975s and C145s.

Shin Meiwa were responsible for the assembly of the Westland Widgeon helicopter sold to a Japanese electricity company, which also has two S.51s, and put together another five W.S.51s for the MSDF. The company's interest in helicopters was strengthened by liaison with the American Vertol concern, whose H-21 tandem-rotor machine was evaluated by the MSDF against the Sikorsky S.58.

Had the H-21 been successful it might have been produced by Shin Meiwa, but the Japanese company is now interested in the Vertol V-107 twin-turbine helicopter. This has a possible application for all three Japanese Self-Defence Forces, and will be entered for the next competitive evaluation of rotorcraft by the military authorities.

With its responsibility for the tail sections of the 42 MSDF Neptunes, Shin Meiwa has a natural emphasis on production rather than design, but the long-established interest in flying-boats is being maintained by general hydrodynamic research and the detailed exploration of several projects. One of these is for a flying-boat trainer to supplement the MSDF's four Grumman Geese, which next year are due for replacement by Grumman Albatross amphibians. Layout of the 5/6-seat Shin Meiwa boat will be similar to the Goose, power being



This selection of MSDF types includes a Kawasaki-built Bell 47G, a Westland - Sikorsky S.51, a Sikorsky S.55, and a Kawasaki KAL-2.

The Japanese Air Self-Defence Force has so far three wings of F-86F Sabre day-fighter/ground-attack aircraft, which have been built by Mitsubishi since late 1956. Three hundred Sabres will have been produced in Japan by the time the programme is completed in 1960.

supplied by two GSO-480 engines, but the hull will have a high fineness ratio rather like the Martin Marlin.

Another project, of a rather different nature, was the T1K1, which was one of the four entries for the jet trainer competition won by Fuji. Mitsubishi and Kawasaki also submitted designs, which conformed to the specified J-3/Orpheus powerplant. The Shin Meiwa project was a conventional and quite attractive design, with unswept wings or tail, side-by-side seating and cheek intakes, but is now shelved.

Apart from its participation in the YS-11 collective transport project, described in THE AEROPLANE last week, the principal remaining aeronautical activity of Shin Meiwa, with its 1,282,161 sq. ft. of floor space in three plants, and over 2,000 personnel, concerns the production of metal drop tanks for F-86F Sabres. Production of these 106-Imp. gal. tanks began for the U.S.A.F. during the Korean War, and except for 1,000 produced for the JASDF the entire 60,000 tanks since built have been supplied to the Americans. The tanks are said to be cheaper than their U.S.-built equivalents, and are certainly at least as good in quality.

Shin Mitsubishi Jukogyo K.K. (Mitsubishi Heavy Industries Reorganized, Ltd.). The aircraft division of this veteran and massive company has, with Kawasaki, the largest output in the national aviation industry, its three factories at Oye, Komaki and Daiko, in the Nagoya region having a combined floor space of 1,388,000 sq. ft., and employing 5,100 personnel. This production area is about one-tenth of the Wartime peak, in 1944, but Mitsubishi by V-J Day had a backlog of experience accrued from building some 18,000 aircraft (including many thousand Zeros) and 52,000 engines since its foundation in 1920.

The company resumed its aircraft activities in 1952, and in the following March, the repair and overhaul of U.S.A.F. B-26s, C-46s and F-86 Sabres began at Komaki. The Daiko engine manufacturing plant was also reactivated in 1952, and the overhaul and repair of Pratt & Whitney piston engines, plus production of spare parts, began for civil and military operators in Japan and the Far East. Types dealt with have included R1340s, R1830s, R2000s and R2800s, and more than 300 engines have so far been handled.

In 1954 overhaul activity at Komaki was extended to include the repair and assembly of Sikorsky S.55 helicopters for the U.S.A.F., Japanese forces and other operators, but a major expansion by Mitsubishi followed an agreement between the U.S. and Japanese Governments in June, 1955, for the licensed production of the F-86F Sabre. The F-86 was selected as the standard day fighter/ground-attack aircraft for the JASDF, and contracts were awarded to Mitsubishi for the production of 300 Sabres by March, 1960.

As usual, the first few aircraft were assembled from imported components, the initial Sabre in this programme being flown on August 9, 1956, but subsequent F-86s have been 77% Japanese-built. The J47 engines, instruments and pyrotechnics, including armament and ejection seats, have been supplied by the United States.

From the production point of view, the Sabre, with its milled tapered wing skin and complex hydraulic control systems, is quite a complicated aeroplane, but the well-equipped Mitsubishi lines at Oye and Komaki—the last to continue construction of this remarkable type since North American and Canadair have completed their F-86 schedules—have been turning out about 8-10 aircraft per month. The original contract for 300 Sabres will now be completed in December, 1960, although with the aircraft supplied direct from the U.S., the JASDF already had 310 F-86Fs in October last year.

As the Sabre is now well past its prime, the Japanese have been giving some thought to boosting its performance, and the General commanding the operational units of the JASDF has suggested the installation of a liquid-rocket unit above the J47 tailpipe. This has already been done with a naval version of the Sabre, the FJ-4F Fury, which has an N.A. Rocketdyne AR-1 installed in that position using HTP in conjunction with the normal J.P.4 fuel.

Suitably strengthened, the F-86F with a similar booster rocket is thought by the Japanese to be capable of M=1.2, and to have a greatly improved climb and ceiling. It would prolong the operational life of the Sabre by a considerable amount, which would be invaluable in view of the delay there will inevitably be before the introduction of a successor for the JASDF.

A Sabre Replacement

Although the Grumman G.98J-11, or F11F-1F Tiger, was selected by the Japanese Defence Agency to replace the Sabre, and Mitsubishi were nominated as the prime contractors for its licensed production as long ago as April, 1958, no contract has yet been issued because of prolonged political argument in the Diet. Nor is an official decision apparently expected for several months in the involved domestic situation.

The Super Tiger was selected after the extensive Japanese evaluation of a number of fighters, all of which were American, and also included the North American F-100D and J, the Lockheed F-104A and C, and the Northrop N.156F. One of the main requirements of the JASDF was a multi-mission capability, as only one type of aircraft was desired for procurement. In this view they differed from the Germans, who are buying the F-104 for interception, and the Fiat G.91, with perhaps the F-105, for ground attack.

In its versatility, the Super Tiger was considered, with the F-100J project, to be superior to the F-104, which, however, possessed superior acceleration to all the other types. The Grumman fighter, nevertheless, has the same M=2 speed capability as the F-104, compared with the M=1.5 of the other aircraft evaluated. In climbing performance, the order was F-104, F11F-1F, N.156F, F-100J and F-100D, but only the Super Tiger met the minimum operating radius requirement on internal fuel of 200 nautical miles, the other types requiring drop tanks.

A particularly important feature, in view of the limited amount of flat land in Japan's densely populated islands, was a short take-off and landing performance, and the deck-landing F11F-1F was only beaten in that respect by the N.156F. In Japanese service, Super Tigers will retain their folding wings, but will have no arrester hooks or any other specialized naval equipment.

Sidewinder AAMs were specified as interception armament for the Sabre successor; all the aircraft could carry these, but only the F-100J met the associated all-weather equipment requirement. The development of American fire-control radar will, however, confer this capability to the F11F-1F, which also met the demands for longevity, since it is at an early stage of development. Two prototypes, with the 15,000-lb. J79-GE-3 afterburning turbojets, completed an extensive test programme in mid-1958.

The F-104A was thought by the Japanese to be inferior in safety margins for the operations contemplated, compared with the other types studied, but, with the F-100D, had a favourably short lead time for production. The N.156F was thought worst in that respect, but promised the lowest production and maintenance costs.

Thus, although the Super Tiger is not at present likely to follow the F11F Tiger into U.S. naval service, it was considered the most suitable type for the JASDF, for whom 300 will be required over slightly less than three years. Produced as a joint U.S.-Japanese venture, the relative costs per aircraft in millions of dollars were estimated as .7663 for the F-100D (jigs and tools being supplied free); .8703 for the F-104A; 1.0098 for the F11F-1F; and .8427 for the N.156F (including development costs of three prototypes).

In the meantime, experience with handling supersonic aircraft is being gained by Mitsubishi with the overhaul, since March, 1958, of F-100D Super Sabres, and, in a rather different field,

To succeed the Sabre in its fighter-bomber wings, the JASDF has selected the Grumman G.98J-11 Super Tiger, which is to be built under licence by Shin Mitsubishi. A prototype Super Tiger has flown at 1,220 m.p.h., and up to 76,932 ft.

Mitsubishi Heavy Industries recently began building the Sikorsky S.55 under licence for military and civil operators in Japan, and the first two rotorcraft were delivered in December, 1958, for the JASDF.

the licensed production began last year of Sikorsky S.55 helicopters. About 40 of these rotorcraft are being built by Mitsubishi, for the Japanese forces and civilian use, and the first two S.55Cs were delivered in December, 1958, for the JASDF.

Ten more will follow for the air force, while the GSDF is to have six S.55Cs. The MSDF has ordered six of the higher-powered S.55As, which will be fitted with "dunking sonar" for anti-submarine duties, but the R1340 or R1300 engines for both types will be imported. To meet the Japanese Defence Agency requirement for a turbine helicopter, Mitsubishi also plans to build the Sikorsky S.61 or S.63 at some future date.

The remaining commitments of the company concern the fuselage construction and final assembly of the YS-11 transport, but Mitsubishi also has an extensive research programme, with excellent wind-tunnel, structural-, material- and engine-testing laboratories. Some development has been done towards a supersonic aircraft of Mitsubishi design, and two rocket missiles have been produced for experimental purposes.

Both are powered by Mitsubishi shipyard liquid-rocket units, the TLRM (Test Liquid Rocket Missile) weighing about 1,100 lb. for a length of 19.6 ft. while the TMA (Test Missile "A") weighs only 88 lb. for a length of 6.2 ft. The TLRM, which is still in the design stage, is a test vehicle for a surface-to-air missile, but the TMA is undergoing launching tests in N. Japan for the Defence Agency.

Showa Hikoki (Showa Aircraft Industry Co. Ltd.). This company was not visited in Japan, but it is perhaps the smallest of the six main firms constituting the airframe and engine elements of the industry. Originally established in 1937, the company has its factory at Showa, near Tokyo, where it undertakes the overhaul, repair and modification of aircraft and engines for the U.S. Army and the GSDF.

Nippon Jet Engine Co. As a much slower process, power-plant development in Japan has lagged considerably behind the airframe side of the industry. Only one aero-motor, a small piston engine produced by Kawasaki, is being built by the Japanese industry, and although components for other types are constructed under licence, the powerplants for the aircraft production programme are all imported.

The principal company concerned with turbojets is Ishikawajima Heavy Industries, which manufactures parts at Tanashi for the General Electric J47 and may possibly build the big G.E. J79 for the Super Tiger programme. This company is one of the leading members of a collective concern known as the Nippon Jet Engine Co., the others being the Japan Jet Engine Co., Fuji Heavy Industries, Fuji Motors and Mitsubishi.

Their task has been the development of a fairly small turbojet, which was initially designed by Fuji at Omiya in 1952-53 as the 2,200-lb. JO-1, and is intended as the power unit for the T1F1 jet trainer. As the J3, this engine has been undergoing an extensive test programme in recent months, and is due to enter production in 1960 with Ishikawajima. Provisional plans call for the procurement of 135 J3 engines in three years, to equip 90 T1F1 (T1B) trainers, and provide a reserve.

Bench tests of the JO-3 development engine began on July 3, 1956, and a contract was subsequently placed for three pre-production J3-1 turbojets by the National Defence Agency. One of these units, which developed 2,645-lb. static thrust, was installed beneath the fuselage of a C-46D transport for low-altitude flight tests, and the remaining two were scheduled to be mounted on the wing-tips of a T-33A for testing at high speeds and altitudes. About 15 flights below the C-46 were successfully completed for the initial part of the programme late last year.

The J3-1 is an axial-flow turbojet with an eight-stage compressor and an annular combustion chamber. It has a single-stage turbine with precision-forged blades, and a dual fuel manifold system. Its leading particulars are:—

DIMENSIONS.—Basic diameter, 23.6 in.; overall diameter, 28.35 in.; length, 72.85 in.; frontal area, 3.01 sq. ft.

WEIGHT.—(Dry) 815 lb.

CONSUMPTION.—At normal rating, 1.08 lb./lb. s.t./hr.

Completing the Picture

In all, 16 companies are authorized under the Aircraft Manufacturing Law to produce and repair aircraft or specified equipment, and 40 companies are registered for the construction and repair of accessories and spares. Apart from those described in these articles, however, the companies which warrant special mention as having designed or produced complete aircraft since the War are confined to Shin Tachikawa Kokuki K.K., and Toyo Koku K.K.

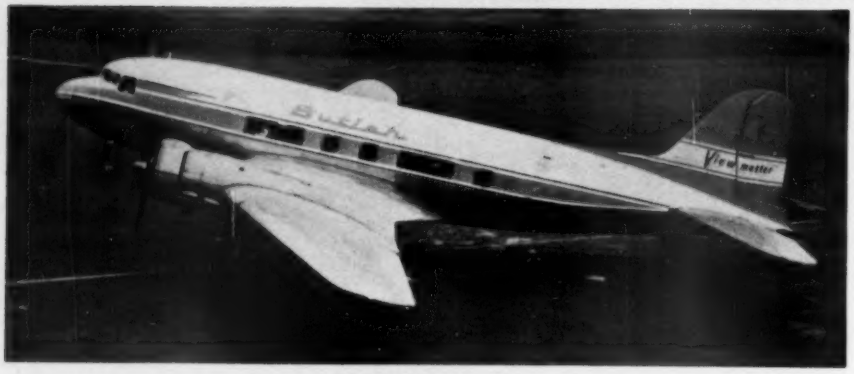
Shin Tachikawa was re-established in 1949 from the former company of a similar name, and produced one prototype each of the R-52 and R-53 two-seat light trainers. It then changed from manufacturing status to one of repair and overhaul.

Toyo Koku was formed in 1952, and produced the TT-10 light aeroplane before taking out the manufacturing and sales licence for the Fletcher FD-25 and FD-25A. Six of these aircraft were built in Japan and exported to the Cambodian Air Force by the company before it ceased operations in 1956.

Low altitude flight tests of the Japanese J3-1 turbojet were completed late last year with the engine mounted below the fuselage of a Curtiss C-46D transport. The 2,645-lb. thrust J3 is being developed to power the Fuji T1F1 jet trainer.

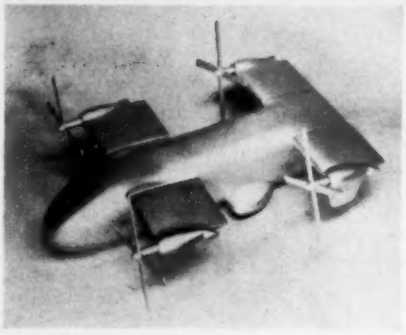
New World Photo-news

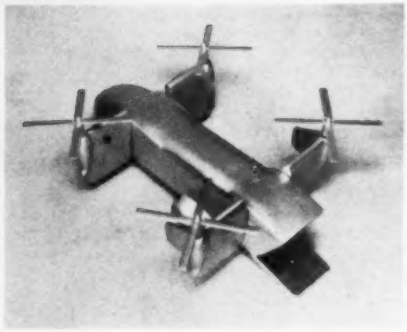
Pictures from Howard Levy



Above, among American home-builts is the Baby Ace, a design dating back to the early 1930s but modernized and made available in plan form by the Experimental Aircraft Association and the Corben Aircraft Co. This one is the spare-time work of Mr. E. Dunn, who calls it the Dunn D-1. It has a 65-h.p. Continental A-65 engine and cruises at 95 m.p.h.

Above, "Viewmaster" is the name which Butler Air Transport has given the Douglas DC-3s which it has converted to give passengers a better view, shown by the enlarged windows. Two DC-3s have so far been modernized in this way.





Above, new projects by Convertawings, Inc., of Amityville, New York, include the V-30 Quadrofoil tilt-wing VTOL aircraft for utility work. It is to have a normal loaded weight of 27,620 lb., including a useful load of 11,640 lb. The engines are to be four General Electric T64 turbines totalling 10,400-lb. thrust. Length, 30 ft.; fuselage width and height, 7 ft. 6 in. and 6 ft. 6 in.

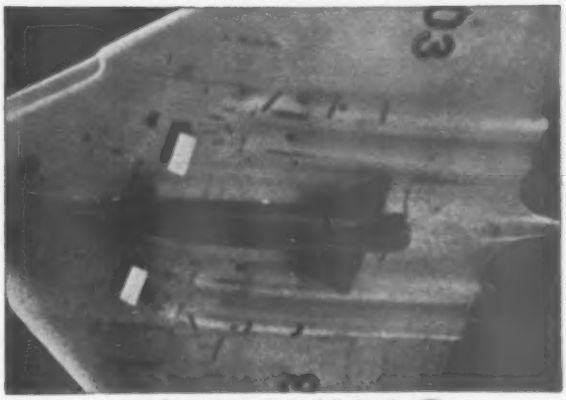
Left, typical of the light single-seat biplanes still in use in the U.S.A. is this Rose Parakeet, powered by a 125-h.p. Lycoming engine. It has a span of 20 ft. and a length of 17 ft. It cruises at 135 m.p.h.

THE

VULCAN

GETS

NEW



STRIKING

POWER

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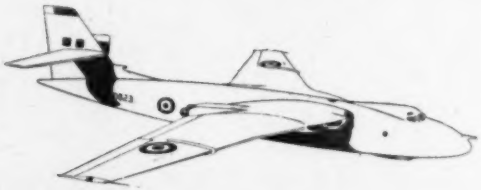
Britain's most advanced V-bomber, the new Avro Vulcan B. Mk. 2, due to enter service with RAF Bomber Command this year, will be equipped to carry one of the most powerful weapons ever invented for the preservation of peace. This is the Avro Stand-off bomb, first air-to-ground guided missile to be developed in this country, which is designed to destroy an enemy target without the aircraft having to penetrate the ring of defences. Designed and built by the Weapons Research Division of A. V. Roe, the Stand-off bomb gives new power to the Avro Vulcan which becomes an even more formidable bulwark against aggression.

AVRO VULCAN

POWERED BY BRISTOL OLYMPUS ENGINES

A. V. ROE & CO. LIMITED, MANCHESTER / ***MEMBER OF HAWKER SIDDELEY AVIATION DIVISION***

FREEDOM OF THE AIR



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The Origin of the Bypass and Ducted Fan

by D. L. Brown, M.I.Mech.E., A.M.I.C.E., M.I.GasE., A.F.R.Ae.S.

THOSE who have read Sir Frank Whittle's book "Jet," published in 1953, may have noticed two points, both of considerable significance today. The first is that when, in 1928-29, he was trying to evolve a suitable powerplant for a high-altitude high-speed aeroplane, his idea for the turbojet was preceded by an arrangement consisting of a piston engine driving a low-pressure ducted fan housed in a hollow nacelle or fuselage. Moreover, provision was made for burning additional fuel in the duct downstream of the fan and before the propelling nozzle.

Thus, chronologically, the idea of the ducted fan and afterburning came before that of the turbojet which was the subject of his Patent of 1930. This type of powerplant was used by the Italians in the Caproni Campini aeroplane of 1940, on which they spent a lot of money before coming to the conclusion reached by Whittle in 1929, namely that it was not worth while. (Whittle found later that the basic concept had been patented by a Dr. Harris of Esher in 1917.)

The second point, which occurs later in the book, is a brief reference to two ducted fan projects known as the L.R.1 and the No. 4 Augmentor, the latter having the fan blades as extensions of turbine blades mounted on rotors in the jet efflux from a Power Jets W.2/700 engine. No further details are given but the reference recalls the fact that the previous year an appeal was heard in the High Court in London by Power Jets (Research and Development) Ltd. for an extension of the life of British Patent No. 471,368 relating to a bypass engine.

For security reasons, much of the evidence at the appeal was heard in camera. But it is significant that the maximum permissible extension of 10 years was granted.

Referring to Whittle's turbojet Patent of 1930, Mr. Justice Lloyd-Jacob said "The basic invention was admittedly the foundation of successful jet propulsion for aircraft, without which high speeds and, in particular, sonic and supersonic speeds for controlled flight would not have been attainable and it has been, rightly, almost universally acclaimed as one of the outstanding achievements of an age itself remarkable for great scientific developments."

On April 26, 1937, a former Director of Scientific Research at the Air Ministry delivered a lecture to a learned society. In it he said that, with contemporary types of engine, the maximum possible speed of level flight was between 500 and 600 m.p.h.; but if there were some entirely new prime mover invented giving vastly greater thrust, it might be possible to attain even higher speeds. He went on to say that there was not the least indication of this being practically possible and so 600 m.p.h. was likely to remain the limit to the speed of human flight.

This was exactly a fortnight after the first run of Whittle's first jet engine, the W/U.

Reverting to the bypass Patent for which an extension was sought, the original application was made on March 4, 1936, and the Complete Specification was accepted on September 3, 1937. It is surprising, therefore, that at the present day, over 20 years later, there is no bypass engine yet in service.

The first cause for delay was undoubtedly the difficulty Whittle experienced in obtaining sufficient official support for the development of even the simple straight jet engine. Then came the necessity under wartime conditions for concentrating to the exclusion of all else on the rapid development and production of that type of engine.

With the nationalization of Power Jets in 1944, the company was no longer allowed to direct its own policy; and by the end of the War, Whittle and the brilliant team which he had gathered round him had been disbanded and Power Jets, as a design and development unit, had virtually ceased to exist.

Thus, as Whittle sadly remarks in "Jet," the two ducted fan projects never came to fruition. As Mr. Justice Lloyd-Jacob remarked "The history of the non-exploitation of the invention after its publication, as deposed to in the evidence before me, is one of almost unrelieved frustration, and the recital by Sir Frank Whittle of his unavailing attempts to awake interest in the bypass engine made melancholy hearing."

Surprisingly enough the Germans were equally slow to take advantage of Whittle's invention, for they had full access to his bypass Patent. In fact the illustrations from it were reproduced in 1939 in the German aviation journal *Flugsport*.

In the early stages Whittle's primary objective was to "gear down the jet" because it was realized from the first that the pure jet engine had low propulsive efficiency until speeds of the order of 1,000 m.p.h. could be attained. A later additional incentive was his view that reductions in aircraft drag at subsonic speeds would reach the point where an aircraft which had adequate power for take-off and climb, would be over-engined for cruise.

The ducted fan plus afterburning seemed to be the answer if the afterburner were used during take-off and initial climb only. Then, of course, the third incentive arose, namely, to provide sufficient power for supersonic flight.

Some Past and Current Developments

During 1943, several types of ducted fan were built by Metropolitan-Vickers for installation behind their F.2 engine. Towards the end of 1946, Dr. Griffith, chief scientist of Rolls-Royce, proposed a bypass engine which never came to fruition.

In October, 1948 a project design was submitted to M.o.S. envisaging a bypass engine of 9,250 lb. thrust and this ultimately led to the start of the design of the first Conway engine in January, 1950. In 1950, in a lecture at the World Power Conference, Dr. S. G. Hooker and Mr. F. M. Owner, of Bristols, referred to the possibilities offered by the bypass engine: and in the same year Turboméca built a small engine of this type known as the Aspin.

Following the necessity of fitting British bypass engines to

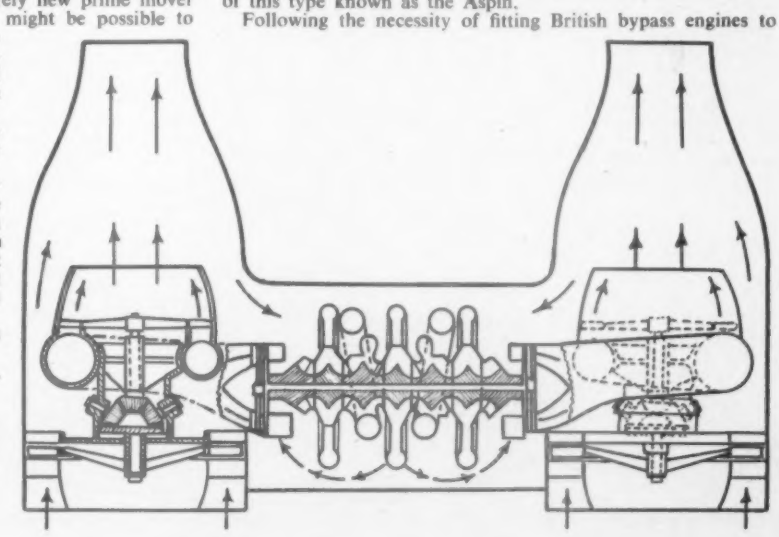


Fig. 1. "The wording of Whittle's Specification of 1936 makes it clear that the advantages of the bypass engine were fully appreciated by him. This Patent envisaged a ducted fan, the delivery from which was divided."

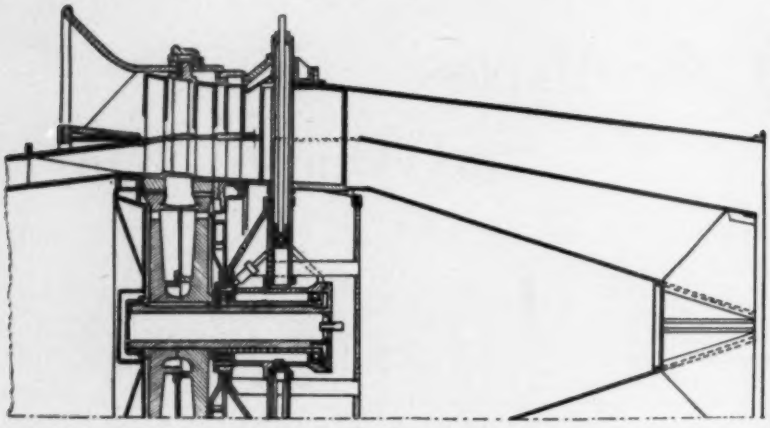


Fig. 2.

the latest American transport aircraft, it is not surprising to learn that the American aero-engine industry is now turning its attention, albeit belatedly, to production of powerplants of the type envisaged by Whittle some two decades ago.

General Electric propose to use a ducted fan mounted at the rear of their C.J. 805 engine, with the idea of enabling existing aircraft to be modified. Pratt & Whitney propose to fit their fan at the forward end of their JT3C engine driven directly from the L.P. compressor. Thus it supercharges the compressor as well as providing a bypass stream.

It is, however, from Whittle's early work that all the latest proposals directly stem.

The Whittle Bypass Patent

The wording of Whittle's Specification of 1936 makes it clear that the advantages of the bypass engine were fully appreciated by him. This Patent envisaged a ducted fan, the delivery from which was divided (Fig. 1).

Part of the air was fed to the intake of a gas turbine the efflux from which drove a further turbine which, in turn, drove the ducted fan. The remainder of the air delivered by the ducted fan mixed in the jet pipe with the hot gases from the turbine. Thus, the total mass-flow of the unit was augmented and the jet velocity reduced.

The Specification states "The primary object is to provide as great a mass-flow of the working fluid as possible. . . . The high mass-flow is particularly desirable in the case of the propulsion of aircraft by fluid reaction in order that the jet velocity shall be as low as possible." This is precisely the principle used in the Rolls-Royce Conway, in the Turboméca Aspin of 1950 and in the current proposals of Pratt & Whitney.

Four years later—in March, 1940—Whittle applied for a Patent covering another type of thrust augmentor. This comprised a twin contra-rotating ducted fan mounted ahead of a jet engine (Fig. 3). By this means the intake air to the jet engine was precompressed at the expense of the pitot energy of the larger quantity of air which was bypassed. The latter was ultimately re-energized by twin fans mounted downstream of the jet engine and extracting energy from the exhaust thereof.

It will be noticed that no stator blades are shown. The idea was that the two freely running rotors should rotate in opposite directions so that the first-stage turbine "windmilled" in the jet stream and at the same time acted as a "stator" for the second stage. The great mechanical simplicity of this idea was very attractive, but detailed investigation showed that it required some very awkward blade angles and Mach numbers. Hence the idea did not pass beyond the stage of sketches and rough design calculations. Instead, Whittle changed to another type of augmentor, the Patent being again dated March, 1940.

The Second Augmentor

This comprised a shrouded turbine mounted behind a jet engine and driven by the jet efflux (Fig. 2). Each turbine blade was extended above the shroud to carry a fan blade, the whole being housed within a duct. The efflux from the jet engine was led through an annular duct to the augmentor turbine; and the ducted fan mounted on the latter induced a flow of air which joined the hot gases downstream of the turbine.

This system, while not "supercharging" the jet engine, did again provide an augmented mass flow and a lowered jet velocity. This idea was revived later and basically it is the system employed in the Metropolitan-Vickers ducted fan of 1943 and in the current proposals of General Electric—in fact the general arrangement of this augmentor was sent to General Electric in 1942, 16 years ago!

About 1941-42, Whittle worked out a scheme for a bypass engine consisting of a very large ducted fan driven by a two-spool engine. The latter consisted of a three-stage axial H.P. compressor driven by a single-stage turbine; and a three-stage L.P. compressor driven by a two-stage turbine.

The L.P. shaft was extended forwards and drove, through gearing, a very large single-stage ducted fan roughly three times the diameter of the gas turbine. This was used partly to supercharge the gas turbine but mostly to bypass it.

The nacelle enclosing the entire powerplant was, in fact, a very thick aerofoil with a thickness/chord ratio of about 0.3-0.35 forming the centre section of a projected four-engined bomber. The upper and lower skins of this centre section were hinged near the trailing edge so as to move through a small angle and thus provide a variable-area nozzle.

A variant of this scheme envisaged a centrifugal H.P. compressor preceded by a six-stage axial L.P. compressor and a two-stage ducted fan. Neither of these engines, however, got beyond the stage of sketches and rough calculations.

These project designs may come as a surprise to those who have come to regard Whittle as the protagonist exclusively of the centrifugal compressor. While he was unquestionably right in concentrating on the latter in the interests of quick production under wartime conditions, it would be doing him a grave injustice to suppose that he was not at all times well aware of the advantages offered by the axial engine. In fact the L.R.1 project, described below and the last design for which Whittle was responsible, was mainly an axial unit.

Another scheme for which, after making some sketches and rough calculations, Whittle applied for a Patent in 1941, comprised four shaft-power cum jet engines contained in a nacelle of about 8 ft. 6 in. in diameter (Fig. 4). These were arranged radially around a central shaft, which was driven through reduction gearing and carried at its forward end a large ducted fan used to supercharge the four engines.

The main nacelle was intended to form the fuselage of a large four-engined bomber, the crew being carried in a conical pressurized nacelle forward of the ducted fan, thus providing an annular intake for the latter.

A variant of this scheme included two gear-driven ducted fans. The high-pressure one was as before, and the low-pressure one was mounted on a gear-driven extension of the

(*Continued on page 315*)

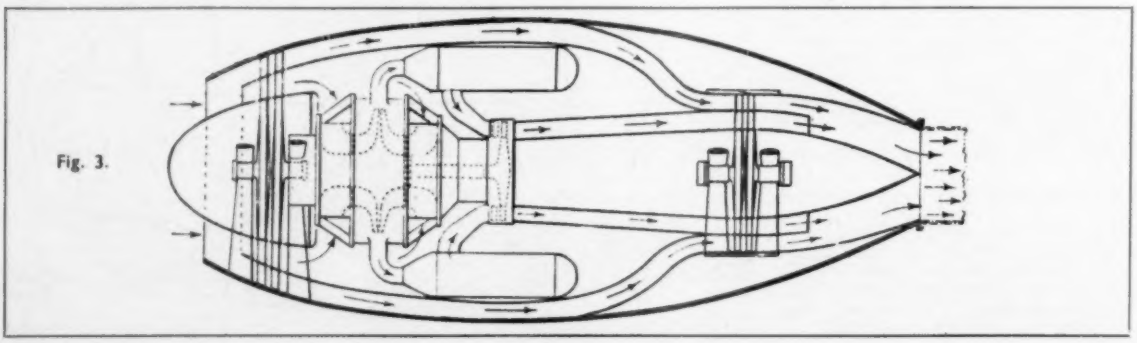


Fig. 3.

EMPHASIS ON MOBILITY

Nowadays changes in strategical concept, the type of defence required, and the very nature and direction of any hostile threat, occur with bewildering rapidity. Deployments undertaken at enormous cost are found to be no longer required. Defences need re-siting. The exact location of static sites becomes common-knowledge. Formations and units in the field need defending.

TO ALL THESE PROBLEMS, THE ANSWER IS

THE 'ENGLISH ELECTRIC' THUNDERBIRD

The ENGLISH ELECTRIC 'Thunderbird', now in production, is a completely mobile ground-to-air weapon system. Its mobility provides the flexibility which is becoming of ever increasing importance in future air defence . . . . **AND THE ECONOMY AS WELL.**

A MEMBER OF THE ENGLISH ELECTRIC AVIATION GROUP

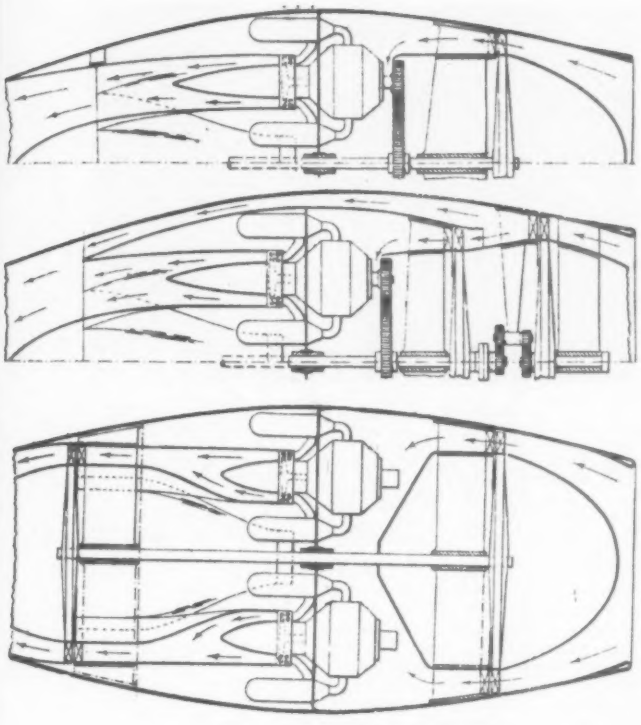
GW213

HATFIELD TO BUENOS AIRES BY COMET 4

7,075 MILES IN 18 HOURS 23 MINUTES

First of six Comet 4 airliners of Aerolineas Argentinas left de Havilland's airfield at Hatfield, England, on the 2nd March, 1959, completing the 7,075 miles delivery flight to Buenos Aires in 18 hours 23 minutes elapsed total time. Aerolineas Argentinas will use these Comets on three routes from Buenos Aires — to New York, London and Santiago — and the aircraft will be operated exclusively on AeroShell Turbine Fuel 650. For over three decades, Aerolineas Argentinas and their predecessors have used Shell Aviation Products.

You can be sure of Shell



Figs. 4, 4A and 4B (top to bottom).

(*Continued from page 314*)

central shaft, its efflux being divided, partly to supercharge the high-pressure fan and partly to provide a bypass stream which was ducted to rejoin the hot gases in the tailpipe downstream of the four engines. (Fig. 4A.)

Another variant of this scheme comprised four jet engines arranged radially around a central shaft carrying at its rear end a large turbine driven by the efflux from the four engines conveyed to it via an annular duct. At its forward end the shaft carried a large ducted fan, the delivery from which was used partly to supercharge the four engines and partly as a bypass stream which was ducted to rejoin the hot gases in the tailpipe downstream of the large turbine. (Fig. 4B.)

Yet another variant of this arrangement consisted of four centrifugal compressors contained in a large nacelle and arranged radially as before around a central shaft and delivering via a series of combustion chambers to a large two-stage turbine mounted on the central shaft. This shaft drove the four compressors through gearing and at its forward end carried a single-stage ducted fan used for supercharging the four compressors via a plenum chamber.

Ahead of this the shaft drove through gearing a very large ducted fan, the output from which bypassed the remainder of the powerplant and joined the hot gases downstream of the turbine. The crew were, as before, housed in a conical nacelle forming the "intake bullet" for the powerplant.

Hitherto, Power Jets had avoided the use of reduction gearing in favour of the various schemes already described, which seemed mechanically simpler. At that time they believed that the "lost wax" method of blade manufacture was the answer to the problems of making double-tiered blading.

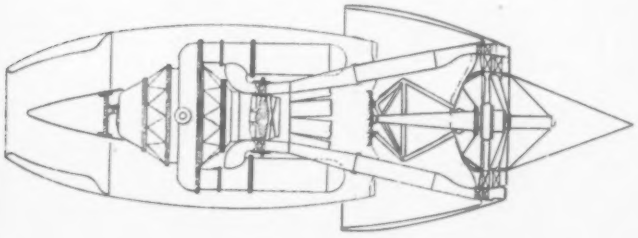


Fig. 5.

However, they ran into various difficulties and this led to the adoption of reduction gearing in this and other later designs.

Unfortunately none of these proposed multiple powerplants got beyond a few sketches and preliminary calculations.

Bypass plus Afterburning

In 1943 came a proposal consisting of a simple centrifugal jet engine driving through gearing at its forward end a ducted fan used, as before, both to supercharge the engine and to provide a bypass stream. In this case, however, the bypass air did not rejoin the hot jet downstream of the turbine. Instead, it flowed through an annular duct surrounding the jet engine and continued aft to the end of the tailpipe. Moreover, in this duct means were provided for afterburning.

Thus, the final efflux consisted of two streams, first the exhaust from the jet engine and secondly the bypass efflux, which could be either "hot" or "cold," depending upon whether or not afterburning was used. Again, the engine was not built.

No. 3 Augmentor

In the same year an augmentor was built wherein the turbine annulus surrounded the fan annulus, the turbine blades being carried as an extension of the fan blades instead of vice versa as hitherto. (Figs. 5 and 6.) In this way the hot turbine blading was relieved of the loads imposed by carrying and driving the fan. In addition, with this arrangement it was possible to achieve much more appropriate blade speeds.

This augmentor was fitted to a W.2/500 engine and had a bypass ratio of 3 : 1. It was also envisaged for use with a projected two-spool centrifugal engine, the L.P. impeller being double-sided and the H.P. impeller single-sided.

On test, however, the performance was found to be very poor because of the interference of the fan turbine ducts with the intake of the fan. This could, perhaps, have been remedied by a certain amount of redesign, but it was decided to revert to the original arrangement with the fan blades mounted on the turbine blading.

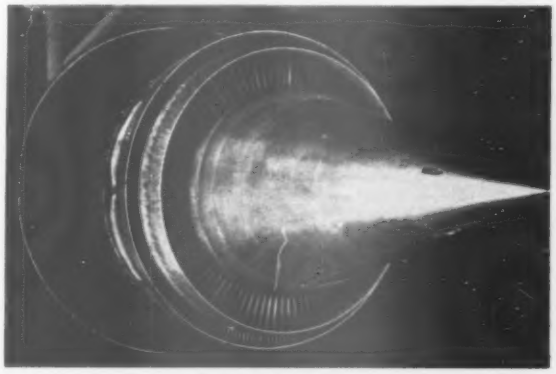


Fig. 6.

Supersonic Powerplant

With the advent of jet propulsion, it became evident that sonic speed would soon be reached and indeed exceeded. The very limited data then available from aircraft flown at high Mach numbers, showed that a host of new problems would be encountered as sonic speed was approached, particularly with regard to control, stability, and lift. In order to obtain data on these problems and their solution, a contract (E.23/43) was placed with Miles for a research aircraft, the powerplant of which was to be produced by Power Jets.

At that time the most suitable engine available was the W.2/700, giving a static thrust of 2,000 lb. at sea level. The specification called for a speed of 1,000 m.p.h. at 36,000 ft. and it was evident that, even with the airframe drag reduced to a minimum, a considerably higher thrust would be required than that delivered by the W.2/700.

Recourse was had to an augmentor of the type already described, with the fan blades mounted outside the turbine blades and having a bypass ratio of 2 : 1 at about 3,700 r.p.m. Provision was made for afterburning and it was estimated that a total net thrust of 3,200 lb. would be available for take-off, the s.f.c. being 1.6.

At 1,000 m.p.h. at 36,000 ft. the estimated net thrust was 4,100 lb. at a s.f.c. of just under 2 and a T_{max} of 1,500°K. With 1,750°K the estimated thrust increased to 6,000 lb. It was then up to Miles to produce an aircraft of the lowest possible drag.

Largely by the use of a very thin wing of biconvex section,

there seemed a reasonable hope of achieving sonic speed in level flight and construction proceeded both of the aircraft and its powerplant, including combustion tests on the afterburner section.

Early in 1946, a few months before the prototype was due to fly, the decision was taken to pursue research at supersonic speeds by means of rocket-powered models of the aircraft then nearing completion. The contract was accordingly cancelled and the following year the U.S.A. were able to claim the honour of being the first to achieve supersonic speed with a piloted aircraft.

Ten years later, the then Minister of Supply stated that the cancellation of the Miles/Whittle research aircraft had been a grave mistake, resulting in a serious setback to the production of high-speed aircraft in this country. It is interesting to note in passing that nearly 13 years had to elapse before a British aeroplane achieved the performance which in 1943 Miles and Whittle were called upon to provide.

L.R.1—Powerplant for a Long-range Project

The idea of this engine started in 1943 as a result of a discussion at the R.A.F. Staff College, inspired by Whittle, on the requirements for a future long-range bomber for use in the Far East theatre of war. The discussion suggested that the probable requirements would be for a radius of action of 2,000 miles at 400-450 m.p.h. at 40,000 ft., carrying a bomb load of 15,000 lb. This necessitated a still-air range of 5,000 miles for which Whittle envisaged a four-engined aircraft with an all-up weight of about 120,000 lb.

With regard to the engine (the letters L.R. standing for "Long Range"), it was decided to use an eight-stage axial compressor (Fig. 7) followed by a centrifugal compressor. The two-stage turbine drove both the compressors and, through gearing, a six-bladed contra-rotating propeller. The design

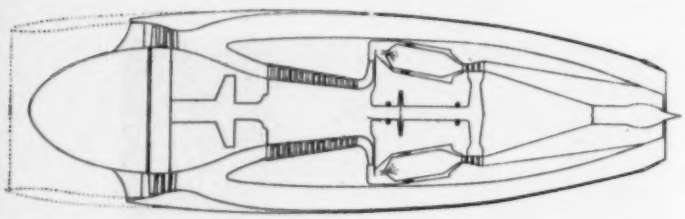


Fig. 8.

condition was based on the cruising requirements which, it was estimated, would necessitate an engine giving a total thrust (propeller plus jet) of 1,700 lb. at 95% full r.p.m. at 470 m.p.h. at 40,000 ft.

For take-off at 8,000 r.p.m. it was estimated that the engine would give 4,670 s.h.p. plus 3,160 lb. jet thrust. Thus the thrust available for take-off would have been something like half the all-up-weight of the aircraft and this, combined with the modest wing loading of 50 lb./sq. ft., would have given an exceptionally short take-off.

The specific fuel consumption under cruising conditions was estimated to be about 0.41 lb./e.s.h.p./hr. The estimated weight of the engine was 3,070 lb. and the overall diameter was 45 in.

Another version of the engine envisaged a ducted fan in place of the propeller (Fig. 8). This had a bypass ratio of 2.5, the fan r.p.m. being 2,300. Under cruise conditions this was estimated to give 2,860 t.h.p. for a fuel consumption of 1,890 lb./hr. and a weight of 2,770 lb.

A straight jet version of the engine was also envisaged giving a static thrust at S.L. of 5,500 lb. for a weight of 2,600 lb. The estimated s.f.c. was about 15% better than that of contemporary jet engines.

In addition, there was a supersonic version driving a ducted fan with afterburning, the bypass ratio being 2.6. The maximum net thrust at 850 m.p.h. at 36,000 ft. was estimated to be 10,350 lb.

A further version envisaged a ducted fan driven by a separate turbine. A propeller version of the engine was also proposed as a powerplant for an aircraft cruising at 300 m.p.h. at 20,000 ft., thus foreseeing the as yet unborn Britannia.

The L.R.1 bomber project was first submitted to the Ministry of Aircraft Production late in 1944; and in April, 1945, a strong plea was put forward that the time was ripe for research and development work on the possibilities and characteristics of the ducted fan, using the L.R.1 engine for this purpose. To envisage in 1944 a machine whose performance is only just being achieved today, some 14 years later, is another illustration of Whittle's remarkable courage and foresight.

Fig. 7.

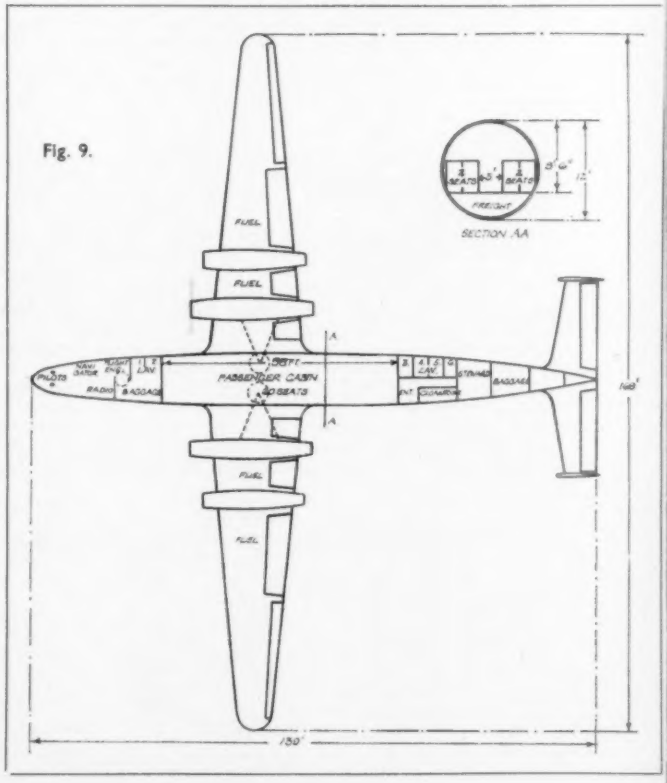
In May, 1945, a project was prepared for a transatlantic civil transport powered by four L.R.1 engines driving ducted fans. (Fig. 9.) The machine was designed to cruise at 470 m.p.h. at 45,000 ft. with a still-air range of 5,280 miles and a payload of 20,000 lb. The estimated all-up weight was 156,000 lb.

The M.A.P. Powerplants Committee considered that future passenger aircraft would not be required to cruise at 470 m.p.h. or at 40,000 ft.: and that the difficulties of providing a suitable pressurized cabin would be enormous.

In August, 1945, Power Jets were given a contract for one engine plus a set of spare parts. During compressor tests at the National Gas Turbine Establishment in 1949 a mechanical failure occurred and the project was dropped.

Today there can be little doubt that Great Britain could have been the first to achieve supersonic flight in 1946 instead of the Americans in 1947. With the advent of engines of similar diameter but of greater thrust than the W.2/700, we could almost certainly have exceeded 1,000 m.p.h. by 1948 instead of 1956. And instead of operating our first high-speed non-stop London-New York services in 1961 using American aeroplanes, albeit powered by British engines, we could have done this 10 years earlier using all-British aircraft.

Fig. 9.



Commercial Aviation Affairs

NO-PASSPORT TRIPS.—Air Charter were to introduce the first "no-passport" day trips by air to France on March 10. The original plans to carry day-trippers on the regular vehicle service from Southend to Calais have had to be augmented with a special DC-4 service to meet the demand. The company reports that it already has more than 7,000 bookings for these trips.

CALAIS EXTENSION.—Modernization of Calais-Marck airport is in progress and the runway is being extended to 4,100 ft. New terminal buildings are expected to be ready in May.

WALL STREET HELIPORT.—A second downtown heliport is to be established in New York following agreement between the Port of New York Authority and the municipal authorities. It will be close to Wall Street on the East River—i.e., on the opposite side of Manhattan from the existing West 30th Street Heliport on the Hudson River. New York Airways is expected to provide services to La Guardia, Newark and Idlewild.

LONDON-MOSCOW.—An easing of the situation over the London-Moscow service prospects seems to be likely and it is now expected that Aeroflot/B.E.A. operations may be able to start in the early summer. B.O.A.C.'s sales development manager, Mr. P. Graham Bell, and interline sales superintendent, Mr. D. F. Johnson, travelled to Moscow by Comet 4 on March 2 in order to discuss future interline arrangements with Aeroflot in preparation for the start of London-Moscow services.

TRANSCONTINENTAL RECORDS.—The flagship of American Airlines' Boeing 707 fleet has established official records between Los Angeles and New York. Times confirmed by the N.A.A. are, eastbound, 4 hr. 3 min. 53.8 sec. and, westbound, 6 hr. 18 min. 57.4 sec.

PUBLIC INQUIRY.—Mr. H. J. Phillimore, Q.C., has been appointed to hold the public inquiry into the accident to an Independent Air Travel Viking at Southall last September. His assessors will be Capt. G. B. Stead, Capt. R. P. Wigley and Mr. E. Gregory. The inquiry opens on March 16.

PACIFIC RESISTANCE.—Northwest Airlines, the transcontinental and trans-Pacific operator, has asked the U.S. Civil Aeronautics Board to reconsider the extension of B.O.A.C.'s service from San Francisco to Tokyo. Pacific traffic rights for the U.K. were written into the 1946 Bermuda agreement and approval was agreed in January, 1957, for the Tokyo service—so it does not seem likely that the Northwest objection can be sustained.

AIR BRIDGE SERVICE.—Emergency spares for motor coaches touring the Continent are being carried by Air Charter Ltd., from Southend. Note the clean loading ramp.

B.E.A. FREIGHTING.—As already recorded B.E.A. carried 18% more freight in 1958 than in 1957. This figure represents a total of £1,686,000 in airmail revenue and £2,032,000 in general freight revenue. B.E.A. now operates over 100 all-freight services a week, but 64.3% of the total is still carried on normal scheduled passenger services.

COMET TO ARGENTINA.—The first Comet 4 for Aerolineas Argentinas was delivered to Buenos Aires on March 2, in 16 hr. 3 min. flying time at an average speed of 441 m.p.h. The sectors, with distances and times, were:—Hatfield-Dakar 2,713 st. m. (6 hr. 18 min.); Dakar-Recife 1,986 st. m. (4 hr. 34 min.); and Recife-Buenos Aires 2,376 st. m. (5 hr. 36 min.).

AIR INDIA TRAINING.—Captain P. D. Byramji, Air India International's divisional operations manager (training and licensing) and three senior instructors are taking a two-week transition training course on the Rolls-Royce Conway at Derby before going to Seattle for a five-week course on the Boeing 707, and to New Jersey for a two-week course on the Curtiss-Wright 707 flight simulator.

INTERFLUG.—A new state-sponsored air transport organization, Interflug, has been formed in East Germany. So far as can be understood Interflug is the name under which all the international operations of the East German Lufthansa will now be flown. There has, in the past, been considerable confusion because of the use of the name Lufthansa for the companies in both West and East Germany.

TRAFFIC INCREASE.—In February American Airlines broke previous records for passenger traffic with an estimated 364 million passenger-miles by comparison with 337 million in February, 1958. The increase was due in part to the introduction of Boeing 707s which, in their first five weeks of operation, averaged a load factor of 96.2%. American will put 707s on the New York-Chicago-San Francisco route on March 22.

CHERBOURG FERRY.—Silver City's vehicle and passenger services to and from Cherbourg will operate, until further notice, from Bournemouth Airport, Hurn. Eastleigh, Southampton, has been temporarily closed because of unserviceability.

LIBERAL ECONOMY.—Among the agreements at the IATA traffic conferences in Paris was one to the effect that, from April 1, economy class passengers will enjoy a service of cold meals in place of the sandwiches now stipulated. From October 1 the sale of alcoholic beverages will also be permitted.

AND NOW T.W.A.—On March 20 Trans World Airlines will introduce 707-120s on the New York-San Francisco route.

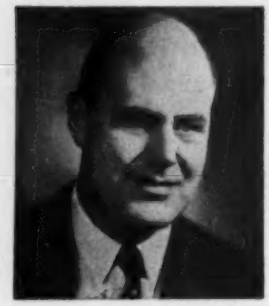
VISCOUNT LOST.—One of the two Viscount 784s leased by TACA International Airlines from Philippine Air Lines crashed when taking off from Managua, Nicaragua, on March 5. Thirteen of the 15 occupants were killed.

PROGRESSION.—After a two-week spell on the ground for additional test instrumentation to be installed, the Convair 880 is now continuing its trials. The initial test phase covered 14 hr. 59 min. in seven flights in eleven days from the first flight on January 27.

Dowty's Deputy Chairman

MR. ROBERT H. HUNT, A.F.R.Ae.S., A.F.C.A.I., a director of the Dowty Group, Ltd., has been elected deputy chairman of the company.

He started his career with the company as an apprentice in 1935. When the War started in 1939 he was attached to Technical Training Command, R.A.F., although remaining an



Mr. Robert H. Hunt, the new deputy chairman of the Dowty Group.

employee of the company, and until 1943 was chief instructor of a training school specializing in hydraulics.

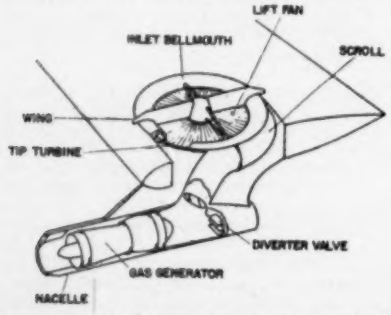
In 1945, after a year in a liaison capacity between the company and its Canadian subsidiary, Mr. Hunt was appointed export manager. In 1948 he moved to Ontario as vice-president and general manager of Dowty Equipment of Canada, Ltd. He became president of that concern in 1950.

While retaining this presidency he returned to England three years ago and joined the board of the British company.

Mr. Hunt is aged 40, and was educated at Cheltenham Grammar School and the North Gloucester Technical College.

Convertible Turbojets for VTOL

FROM the United States comes news of an interesting new form of powerplant arrangement intended specifically for VTOL aircraft. This is a "convertible" turbojet propulsion system which has been the subject of a design study by General Electric. The work has been done under a U.S. Army contract which covered, in the main, engines for subsonic relatively low-altitude aircraft for cargo carrying and observation duties.



This convertible VTOL powerplant would use a conventional jet engine and a tip-turbine-driven lift fan as basic components. It would have the turbojet engine mounted in a conventional pod nacelle carried by a swept strut from the wing. Aft of the turbojet engine are "diverter valves"—one in the tailpipe and one in the duct leading to the lift fan which provides the take-off thrust augmentation.

For vertical flight the tailpipe valve is closed and the valve leading to the lift fan is opened, permitting exhaust gases to pass through an interburner where additional energy may be added. From the interburner, the hot gases are ducted to the scroll of the tip-turbine which drives the lift fan. Exhaust gases are ejected downward from the tip-turbine so that the residual velocity adds to the thrust of the lift fan.

The fan, itself, is similar to a moderately high solidity compressor inlet stage and is mounted on a suitable structure from the wing spars. Air is taken in through a bellmouth intake and is exhausted vertically downward.

Not shown in the accompanying illustration are exit louvres which direct the fan flow in a rearward direction when forward motion of the aircraft is required during transition. During cruise, when the fan is not operating, these louvres close and seal the bottom surface of the wing. Inlet louvres may also be provided on the upper surfaces of the wing and closed during forward flight. During forward flight above the transition point the powerplant operates as a conventional turbojet engine.

Features claimed for the General Electric convertible VTOL powerplant include: (a) Better matching between cruise and lift thrust; (b) thrust vectoring without engine or wing rotation; and (c) no flight speed limitations.

Mr. F. L. Wills Retires

AFTER 39 years' connection with air-survey matters, Mr. Francis L. Wills, M.B.E., F.R.P.S., F.I.B.P., F.R.S.A., has retired from his position as managing director of Hunting Aerosurveys, Ltd., but continues to serve on the board.

Mr. T. D. Weatherhead. Mr. Francis L. Wills.

Born on August 3, 1893, and educated at University College School, Mr. Wills served in the R.N.A.S and R.A.F. during the First World War. In 1919 he became a founder-director of Aerofilms, Ltd., and was subsequently director of the Aircraft Operating Co., Ltd., and of its South African associate company. Among his many duties he was responsible for organizing the companies' photographic sections.

At the outbreak of the Second World War in 1939 Mr. Wills was recalled to the R.A.F. as a Squadron Leader, and served until 1945, when he returned to his former civilian duties.

Mr. T. D. Weatherhead, O.B.E., who has been general manager of Hunting Aerosurveys for the past seven years, has been appointed managing director in succession to Mr. Wills as from the beginning of this year.

Cheerful Departure

ONE of the Industry's "characters" retired at the end of February. John "Joe" Bewsher, Vickers-Armstrongs Aircraft Design Office Administrative Manager at Weybridge, was given a lively send-off party in the company's sports pavilion by some 200 Vickers and M.o.S. friends, headed by Sir George Edwards, Mr. Tom Gammon and several executives.

Something new in the way of farewell gifts was a "This Is Your Life" album of 22 cartoons produced by myself from a profound briefing by Joe's associates Bill Titcombe and Ernie Comfort. The drawings were first projected as lantern slides for us all to make ribald comment upon, then Sir George presented the album and a cheque after speaking in praise of Joe, among whose sterling qualities, he said, was that of telling the boss where he got off, something which he, Sir George, encouraged—provided that it didn't go too far!

Ernie Comfort was with Joe in the Sopwith Drawing Office under R. J. Ashfield, now a senior designer at Fairey's. Robert Noorduyn, who died only a few days ago, was also a member of the team before he went to Canada and designed the versatile Norseman monoplane. These men, with S. H. Smith, were the nucleus of the team which designed the famous World War 1 Sopwith aeroplanes. In the early '20s, Smith, Joe, and Ernie, in Japan, helped establish the design side of Mitsubishi.

Back in England with the Air Navigation Engineering Co. during 1923-26, Joe Bewsher took over the design work of the A.N.E.C. Missel Thrush 2-seater, redesigned the big single-engined A.N.E.C.3 from a monoplane to biplane for operation

by the Australian Larkin Co. then he produced a side-by-side 2-seater called the A.L.1 for a Mr. Grant of Surrey Flying Services, a twin-boom, single-engined 6-seater, known as the "Henderson Horror," for Col. Henderson's Flying School, Brooklands, and a sailplane for Mr. R. F. Dagnall whose initials form the name of the company, R.F.D. Co., Ltd., which is known today for its dinghies and other products.

Joining Vickers, Joe worked under Rex Pierson and came to design the Vildebeeste's flying controls, the Jockey single-seat fighter and its hotter derivative, the Venom, on which Martlesham issued one of the most favourable reports in their history. For various reasons, including a shortage of appropriate engines, it was dropped and Joe went on to design work with the Wellington, Warwick and Windsor.—WREN.

U.S. Space Programme Costs

DR. T. KEITH GLENNAN, the NASA administrator, has said that the level of the U.S. space effort is minimal if goals are to be reached as rapidly as they must be. But in the early stages of planning and beginning programmes there are limits to the amount of money which can usefully be spent. Down payments are being made on programmes which will inevitably cost much more in the years ahead.

The cost of the man-in-space programme, Project Mercury, will be nearly £21 million during 1959, and its cost in 1960 will rise to £25 million; the bill will exceed £71 million before the first U.S. effort to put man into space has been completed.

The 1-1½ million-lb.-thrust engine now under development is a £4½-million item in the 1959 budget; its cost will increase to £10.8 million in the 1960 budget. Before this single-chamber booster has been brought into service its cost will have exceeded £71 million. Each time one of these giant boosters is used to send many tons of payload into space the expenditure will be more than £7 million. In Dr. Glennan's opinion the cost of the national booster programme, designed to provide building block units of basic rocket motors needed for space programmes, will exceed £712 million.

Speaking of the 1959 NASA programme, Dr. Glennan said that about 15 satellites would be launched, with a similar number to follow in 1960. About 40 sounding rockets will be fired in 1959 and about 100 in 1960. The budget estimate for NASA expenditure in 1960 is £173 million.

Fred Rowarth

THE untimely death of Fred Rowarth, F.R.Ae.S., on February 27 at the age of 59, breaks a link with those happy days of air racing which began after the First World War and ended with the outbreak of the Second. Primarily concerned in recent years with the sales side of British Lockheed as general sales manager and director of Automotive Products, Ltd., Rowarth was to be seen at most of the air racing events in this country. His genial presence will be much missed at the annual competition for the British Lockheed International Aerobatic Trophy given by his company. His partnership with Wilfred Dancy in the handicapping of King's Cup and other races will be long remembered.

That partnership, almost as well known as a music-hall turn and just as amusing, was an integral part of the air-racing scene, and the high modern standards of timing and speed assessment owe much to the pioneer work of the two men who pulled off some surprisingly close finishes. It was all done on the friendliest of terms, and achieved in spite of the most astute artifice on the part of the racing pilots to improve the speeds of their aircraft without showing how they did it.

The partnership had begun many years before when they were both young men in the airworthiness department of the R.A.E. and their chief, Goodman Crouch, did handicapping for R.Ae.C. events such as the Aerial Derby. Rowarth went off to another appointment away from the R.A.E. and Dancy remained with Goodman Crouch. When the latter left for the United States in 1928, Rowarth was invited to resume his partnership with his former colleague. He did and they prospered.

Rowarth and Dancy, accoutred with tape measures and slide rules, came in for some merciless criticism and leg-pulling from the competitors and many were the complaints of unfavourable allowances. ("What do you think I'm flying, the S.6?" asked one.) But they always managed to take them in good part, although, as Rowarth said at a R.Ae.C. dinner a few years ago, they never forgave W. L. Hope for putting such a fast one over them in 1932!

Fred Rowarth was born on June 6, 1899, and educated at Christ's Hospital. From 1920 to 1936 he held various appointments in the Directorate of Technical Development at the Air Ministry and at the Royal Aircraft Establishment at Farnborough. After that he became chief engineer of the Aircraft and Armament Experimental Establishment, holding that post until 1942, by which time the Establishment had moved from Martlesham to Boscombe Down. Thereafter, until the end of the War, he served as deputy director, Installation Research.

It was in 1945 that Rowarth went to Automotive Products as general sales manager, and he became an executive director in 1956. He served in a similar capacity with the associated companies of Borg and Beck, Lockheed Hydraulic Brake Co., and Lockheed Precision Products. During this period his already high standing in the industry increased and his circle of associates expanded.

When the Dancy-Rowarth handicapping partnership reluctantly came to an end in 1948 and D. J. Lyons was appointed chief handicapper to the R.Ae.C. Fred Rowarth continued for some years as a consultant, when his wide experience was always of value.

His death will be widely regretted. He had a comprehensive circle of friends in both the aircraft and motor industries, and particularly to his widow and two sons do we tender our deepest sympathy.

Robert Noorduyn

THE death of Robert B. Churchill Noorduyn, F.R.Ae.S., is reported from Burlington, Vermont.

He was born at Nimegen, Holland, on April 6, 1893, and entered the aviation world as an apprentice with the Sopwith Aviation Co. in 1913. From the next year until 1917 he worked under Frederick Koolhoven at Armstrong Whitworth, and became responsible for production of the FK.8 army-observation biplane for the R.F.C.

For the next three years Noorduyn served as Koolhoven's personal assistant at the British Air Transport Co., Ltd., and supervised production of the various B.A.T. designs, including the FK.26, one of the first commercial aircraft.

When the B.A.T. closed down in 1920 Noorduyn went to Fokkers, and became general manager of that company's U.S. concern. He stayed there until 1929 and for two years was vice-president of the Bellanca Aircraft Corpn. Later he designed the Pitcairn Autogiro.

It was in 1934 that he began aircraft design in Canada, and in the following year formed Noorduyn Aircraft, Ltd., at St. Laurent, P.Q. This company was responsible for the well-known Norseman general-purpose single-engined monoplane. It was designed primarily for and after consultation with Canadian operators, and was used by numerous bush-flying companies, the R.C.A.F. and R.C.M.P., and by the U.S.A.A.F. as the UC-64.

Noorduyn retired from this company in 1945, and became vice-president and general manager of Polamat, Ltd., of Montreal.

A. R. Weyl

THE tragic death on February 23 of Alfred Richard Weyl robbed British aviation of yet another of its few remaining forceful, if rather turbulent, individualists. Born in Berlin, Weyl was an early victim of Nazi oppression and he had to seek refuge in this country, eventually becoming a British citizen.

Since the War, fortune did not favour him and, despite his proven abilities and the country's need of tried engineers, he had to exist for the most part as a consultant.

In World War 1 Weyl was a front-line pilot with the German Air Force and, after studying at the Berlin Technical University, served with the *Reichsluftamt* and the DVL, the aeronautical research centre. After being principal assistant to the Chair in Aeronautics at Berlin Technical University and being in charge of R. and D. projects for the Defence Ministry, he went to the Udet-Flugzeugbau, Munich (which later became the B.F.W., Messerschmitt works) where he designed what is believed to be the first wooden low-wing cantilever monoplane ever flown.

Most interesting of Weyl's aeroplanes was the Kitten, which was built and flown in 1935-36 by his English company, Dart Aircraft, Ltd. The Kitten ultra-light, single-seater, of which at least two are still flying, showed the originality of its designer-pilot's mind by the wing shape. By a judicious change of section and incidence at the tip, full aileron control was available at the stall on an unslotted tapered wing for the first time.

In addition to his technical work, Weyl's intense energy made him a prolific writer and he published numerous serious technical works. J.H.S.

Private Flying

H.J.C.'s CLUB COMMENTARY

● THOSE who have been active in trying to get the Minister of Transport and Civil Aviation to change his mind about Croydon can feel satisfaction that some measure of success has been achieved.

In a written answer on March 2 Mr. Watkinson stated that, resulting from the accommodation of some clubs at Biggin Hill, movements at Croydon are now less than a quarter of what they were a year ago.

He has now decided that Croydon will be closed for general flying on May 1—which is an extension of four months over the original closing date. Nevertheless he is prepared, as an exception and for a short period after May 1, to give special permission for commercial firms to continue scheduled and charter flying and flights connected with maintenance and delivery up to September 30.

This concession is made only to firms which satisfy the Minister that they are making all possible efforts to find alternative accommodation. On September 30 M.T.C.A. facilities and services will be withdrawn, and no night flying will be permitted in the meantime, except in emergency.

But the written answer does not qualify the "alternative accommodation" by the word "suitable." There is still no real security of tenure at Biggin Hill, and no plans for removal to Gatwick can yet be completed without more positive information about rents there.

● ANOTHER tenant now at Biggin Hill (in addition to the Surrey and Kent Flying Club) is the **Experimental Flying Group.** Its aircraft were flown to the new site on February 15, nearly five years after the group had transferred from Redhill to Croydon.

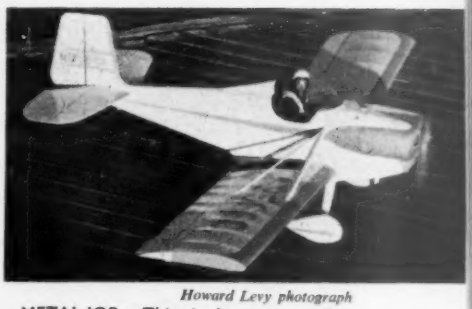
A timber building has been rented at Biggin, and members are now working at week-ends to turn it into a clubhouse and offices—in fact facilities which they had been unable to obtain at Croydon. The clubhouse is at the western end of the east-west runway.

The group operates two Hawk-Trainer 3s, G-AITN and AKAS, and the flying rate is now 54s. an hour, dual and solo.

Plans for the third summer camp have been made: Christchurch will be visited during the second week in June. This year's contest for the Jean Bird Memorial Cup, for navigation, is to start next month.

● SPEAKING at the annual meeting and luncheon of the **Royal Canadian Flying Clubs Association** in Ottawa on February 16, Mr. J. R. Baldwin, Deputy Minister of Transport, reminded members that while 1959 is the 50th anniversary of powered flight in Canada it is also the 30th birthday of the Association.

It was in 1929 that meetings were held which led to the formation of the Association, whose first annual meeting took place in November of that year. Mr. Baldwin paid some tribute to the great record of the clubs since then, and of the steady growth up to the outbreak of the Second World War. When the War began the clubs continued the elementary training of R.C.A.F. pilots which had begun in the previous June. This led to unusual growth of the movement, and the vast amount of flying under the Commonwealth Air Training Plan.



Howard Levy photograph

METAL JOB.—This single-seater, with a 65-h.p. Continental engine, is an original home-built design by Kenneth Bowser and Gailard Barker of Phoenix, Arizona. Many midnight hours were spent on it—hence it is called the B-B Midniter. A cut-down Cessna wing of 23 ft. 7 in. span is used. The Midniter cruises at 100 m.p.h.

With the return of peace the clubs reverted to their earlier rôle, and in particular outstanding work has been done in connection with the training of air and naval cadets, air training for the Army, and R.C.A.F. and civil refresher courses.

The Deputy Minister ended his speech with a reference to the plan under which the Canadian clubs receive direct or indirect financial assistance, and reiterated the indication earlier given by the Minister to the effect that the clubs should make every effort to achieve a position where they can stand on their own feet financially.

Gliding Notes

by Dr. A. E. Slater

WINNER of the Australian Gliding Championships, held at the turn of the year at Benalla, Victoria, was J. M. Iggulden, of the Victoria Motorless Flying Group, who, Mr. L. H. Yardley writes, collected 94% of the possible marks. John Iggulden is secretary of the Gliding Federation of Australia. Second came Rupert Brown, with 92.7% in a Skylark belonging to the same Group; and the same Skylark, in which Walter Burgess and Gordon Macdonald also shared the flying, took first prize in the team contest with an average marking of 70%.

All States were represented among the 16 entries, except Tasmania and Queensland.

The first task, an 80-mile goal flight, was won by Burgess in the Skylark on his second try, taking 2 hr. 4 min. The second was a 100-km. triangle race, for which B. Slurasrev of the Victoria Group set up the nrst Australian record of the kind with 1 hr. 26 min. in a German Lo-150. There followed a no-contest day on which less than a fifth of the competitors scored marks.

Then came a 300-km. triangle, which nobody managed to complete because of an unexpectedly strong south wind, followed by a 103-mile out-and-return which all but three completed; in each of these contests a two-seat Kookaburra, of Australian design, gained most marks, evidently by virtue of a handicap allowance. Second place on the out-and-return was shared by R. Frecheville, who has flown for many years past at the Derbyshire and Lancashire Gliding Club.

A 300-km. triangle was at last achieved by an Olympia which Ewen Cameron flew round in 6¼ hr., a record for Australia, on behalf of the Gliding Club of Victoria (who were hosts), and by J. M. Iggulden with the Gull 4 in 6¾ hr. The same Olympia won a goal race next day in the hands of Owen Lewis, with the Royal Australian Navy's Nymph coming second.

The last three tasks, a 100-km. triangle, a 200-km. triangle, and a 164-mile out-and-return, were not completed by anybody; the best performances were respectively by the Victoria G.C.'s Kookaburra (helped again by its handicap), Rupert Brown in the Skylark (7 miles short), and J. M. Iggulden.

Altogether 413 hr. were flown and 9,100 miles covered, both figures being records for an Australian gliding meeting.

* * *

REARRANGEMENT of the programme of annual meetings announced for March 14 is announced. The annual general meeting of the British Gliding Association will start in Londonderry House at 10.00 hrs. instead of in the afternoon, thus allowing 8 hr. for bed and breakfast after the ball is over. It will be followed by a meeting of associate member clubs. The Instructors' Conference will start at 11.30 hrs. in the Kronfeld Club and carry on as long as desired. The club secretaries', managers' and treasurers' conference will start at 14.15 hrs.

* * *

OXFORD GLIDING CLUB turned up in some force at the London Club on February 8, when it was too murky for either club to fly. The Oxford club differs from Cambridge in that only 18 members come from the university. There are about 80 members in all, and the fleet consists of a T-21, Olympia and Grunau Baby, while a Skylark 2 is on the way.

They are restricted to week-end flying because Weston-on-the-Green, where they operate, is a Service aerodrome. But although Cambridge club can fly any day of the week at Marshall's, the aeroplanes there have priority even on Sunday; when I was there on February 15, Tigers were happily taking off, while the gliders were grounded because horizontal visibility was less than 1½ miles.

The Oxford Club had many more university members during its short pre-War career but even then Robert Kronfeld, who was club manager, concentrated on "A" and "B" certificates because he thought gliding could only be sold to the public as a useful preliminary to power flying, rather than as a means to soaring flight.

For some reason Oxford has never been in a position to challenge Cambridge to an inter-varsity soaring match. Cambridge benefits much from the large number of former undergraduate members who have settled down there to earn a living and still serve the gliding club with undiminished devotion.

* * *

A NORFOLK Gliding Club has been formed and the committee has, it is reported, "bought an aircraft which they are hoping to convert into a two-seater." There is the usual trouble about trying to find an airfield. Norfolk has not had a gliding club since the gliding section of the Norfolk and Norwich Aero Club operated in pre-War days; they used to do a fair amount of flying after initial trouble with "experienced aeroplane pilots" who would spin their Kestrel into the ground from an auto-tow.

A gliding club has been formed in Doncaster, but so far without a glider or a field. And at Swindon Mr. S. P. Woodley, general manager of Vickers-Armstrongs at South Marston, has offered a flying ground to a prospective gliding club.

Correspondence

Sub Lieut. Warneford, V.C.

IN order to complete a collection of portraits of officers who gained the V.C. whilst engaged on naval flying duties during both World Wars, photographs of Sub Lieut. Warneford are being sought on loan so that a portrait of this officer may be painted.

Great care would be taken with any suitable photographs which would be returned unharmed as soon as the artist had finished with them.

Anyone who can help in this matter is asked to write to the Wardroom Mess Secretary, Royal Naval Air Station, Lee-on-Solent, Hants.

R.N.A.S., Lee-on-Solent. DENNIS B. WHITTON (Lieut. Cdr. R.N.).

Still the MACships Come

IN addition to the 14 MACships mentioned in your issue of February 6, we think that there were also the following tankers: "Acavus"; "Amastra"; "Ancylus"; "Rapana." There was also the dry cargo ship "Empire Macrae."

Edinburgh, 2. WM. THOMSON AND CO.

Aerial Derby Winner

IN the "Correspondence" column of your issue dated February 20 and under the heading "The Green Engine" you append a footnote and the type of aircraft which won the 1919 Aerial Derby is, I think, misquoted. It was, in fact, a conversion of the D.H.9A and was known as the Airco D.H.9R. As a ground engineer I helped to maintain it.

Woking. W. E. CLARK.

[We have noted before a certain light-heartedness in distinguishing the D.H.9 from the D.H.4. Our information was obtained from THE AEROPLANE of the period.—ED.]

Honour Where Due

I WAS delighted to see my old friend John Blake airing his French in THE AEROPLANE on February 20 and I am sure it is not his fault that he is credited with Librarianship of the R.Ae.S. instead of the R.Ae.C.

My moustache is a little shorter otherwise I can well understand the confusion—in a dim light.

Remind me to address you at Stamford Street sometime.

London, W.1. F. H. SMITH, Librarian. (Royal Aeronautical Society.)

[We are glad to have confirmation from the horse's mouth that one librarian is very much like another.—ED.]

Steel Honeycomb Cost

I REFER to "Applications of Metal Honeycomb" in your issue of February 27. The author is, I think, less than fair to steel honeycomb structures. Their cost is not so high as to have prevented many thousands of square feet being embodied in American aircraft. Their practicability does not await the development of high-temperature adhesive—this already exists in the form of braze.

Steel honeycomb is almost certainly an important new "tool" in the hands of both aircraft and engine designers. I lament the fact that we are several years behind America in its application.

London, W.1. PATRICK JOHNSON.

The Turbojet's Downward DOC

IT has recently come to our attention that on page 463 of the September 19, 1958, issue of THE AEROPLANE you make reference to some "Ivory Tower" studies that were performed at "Cornell University," which examine the relative direct operating costs of various types of transport aircraft. In this article you show a figure which purports to result from these studies. The figure you show appears to have been distilled from information contained in this Laboratory's publication, *Research Trends*, Vol. 5, No. 2, Summer, 1957.

In your article you state that the Cornell study concludes that jet aircraft will probably be cheaper to operate than turboprop aircraft over ranges in excess of 400 miles. This statement is not incorrect; however, it is rendered somewhat inaccurate by deletion of information that was originally contained in the conclusion and in the figure you reproduced.

The conclusion that actually resulted from our study was that as aircraft become larger and faster the direct operating cost (DOC) per available seat-mile trends downward. It follows from this that a large turbojet, because it is faster, will have a lower DOC than a turboprop carrying the same payload. However, it is quite possible that a large, long-range turboprop aircraft will have a lower DOC at a given range than a smaller turbojet carrying substantially less payload.

A much more complete analysis of this question is given in this Laboratory's report on the study that was performed for Mr. E. P. Curtis, who was Special Assistant to the President of the United States for Aviation Facilities Planning in 1956 and 1957. (Final Report on National Requirements for Aviation Facilities: 1956-75: Vol. 3 Aircraft Characteristics, Part 1: Civil Aircraft; May, 1957; available from the U.S. Government Printing Office.)

SEYMOUR J. DEITCHMAN,
Head, Operational Systems Section, Systems Synthesis Department, Cornell Aeronautical Laboratory, Inc., of Cornell University.

New York.

Groundabout

P.R.O.-Motion. As suffered the Comet in the beginning, so now suffereth the 707—almost. And in this heartless world of commercial aviation it is now America's turn to endure the macabre jokes, as did D.H. and B.O.A.C. in their time of trial. In fact, some of the cracks are being made by Americans, one of whom observed to me "Your people bury your engines in the wings—we bury ours in French fields." Then there's the reported new twist to airline advertising: "Come for a spin with Pan Am." Some British people express envy at American P.R.O.-manship: "They've turned these set-backs into achievements, emphasizing the strength of an airframe which can survive that kind of treatment!" But then, we do the same—remember the engine fires of the early Britannia and last year's Dart Herald? The "fail-safe"—or "fire-safe"?—virtues were boosted, very properly. That's what P.R.O.s are for.

*

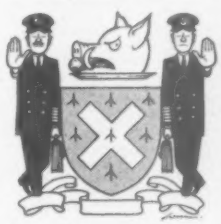
Cometeoric. Meanwhile, the Comet presses on. Although I've Cometed from England to Malta and back between breakfast and tea, its staggering capabilities were never more deeply impressed on me than when I was in the bar of the "Comet" Hotel at Hatfield for a pre-lunch drink on March 2. The pleasant barmaid said to my D.H. host "I heard your Argentine Comet take off at about half-past one this morning. How's it going?" The D.H. man looked at his watch—"It's just about landing in Brazil." We drank to a rosy future for the lovely thing. The Comet, that is.

*

Always Starting Something. Norman "Turbulent" Jones is at it again. Possibly with recollections of the old Hucks starter, he's devised a hand-starter for the little aeroplane's Ardem engine. You just apply it to the prop. hub and work it like a brace and bit. I imagine that Government authority in general and Minister Watkinson in particular, wish that "Turbulent" Jones would keep the bit right there in the brace and not get it between his teeth so firmly and so often, on behalf of private flying.

*

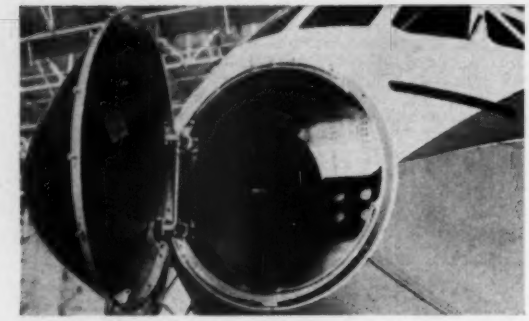
Proper Sinister. Now here, from an affected party, is a suggested coat of arms for the M.T.C.A. which I think Norman Jones would approve. The heraldic description goes: "In chief an aerodrome, defaced by a white cross, semée of caltrops*, having for crest a boar's head, stuffed, proper, bearing in the mouth the apple of discord, supported by two corporations. The motto a complete blank, representing a Ministerial reply to a question, plain, in the House, obfuscated."



* "Sewn with caltrops" which were four-pronged spikes strewn to prevent the use of a field by mounted warriors.

by Gyrene

NOTES AND EVENTS



SEARCH RADAR. — The nose of the first D.H. Comet 4 for Aerolineas Argentinas showing the scanner unit of the Ekco type E160 search radar installation. The aircraft was delivered earlier this month.

AMPLIVOX PUBLICATIONS. — Three new illustrated leaflets describing its fully tropicalized Service-approved miniature earphone and microphone insets have been issued by the Industrial Division of Amplivox, Ltd., Beresford Avenue, Wembley. These lightweight units meet M.o.S. requirements and are generally approved for civil aviation application.

PRICE REDUCTION.—Following the recent reduction in the price of pure magnesium, Magnesium Elektron, Ltd., the sole producer in this country, has announced that the prices of some of its magnesium-alloy ingots have been reduced. This is in keeping with the company's policy to encourage and develop large-scale commercial use of the metal by cutting down the price differential between magnesium and its competitors.

SILICON RECTIFIERS. — Texas Instruments, Ltd., of Bedford, has published the fourth of its reports on the applications of semiconductors. This deals with DC power supply circuits using silicon rectifiers.

THE PAST YEAR.—"This," says an introductory page in "1958 Book of the Year," published by Shell-Mex and B.P., Ltd., "is a book about people." It is indeed much more than that, and presents in a lavish manner many aspects of the organization's World-wide activities. The intriguing story is accompanied by line and half-tone illustrations and colour plates. The last-named consist of photographs and some impressionistic representations seemingly remote from the company's work, yet oddly indicative of how Shell-Mex and B.P. concerns the lives of all. A great deal of thought has gone into this production, which has 42 pp., 9¼ in. by 12¼ in., and is issued by Shell-Mex and B.P., Ltd., Shell-Mex House, Strand, London, W.C.2.

GROUND POWER.—One of the new type 28/112-V. dual-voltage aircraft starting and servicing units which Red Devon, Ltd., has recently supplied to Portugal. The units are self propelled but can be towed by a tractor without any alteration.

TELEVISION CONVENTION.—The British Institution of Radio Engineers is arranging a convention on television engineering in science, industry and broadcasting. To be held in the University of Cambridge between July 1 and 5, the convention will include speakers from a number of overseas countries.

A.R.B. APPROVAL.—The Burgess Products Co., Ltd., of Gateshead, has received A.R.B. approval for its standard miniature micro switch. This, the company states, is the first occasion that such a switch has received approval from the Board.

TEST LABORATORIES.—W. Bryan Savage, Ltd., of 17 Stratton Street, London, W.1, is opening vibration-test laboratories at the end of this month so that the company can undertake vibration/environmental work for customers. This new section will have the full backing of the company's main laboratories.

STOPPING POWER.—A new film has been released by the Dunlop Rubber Co., Ltd., in its series available from the company's film library at Wilton Crescent, London, S.W.19. Entitled "The Power to Stop," this latest release shows how the development of braking systems for aircraft has led to the widespread use of disc brakes in the motor industry. Available in 16-mm. black-and-white film, sound only, it has a running time of 21 min.

RACAL EXPANSION.—The Instrument Division recently announced by Racal Engineering, Ltd., has been formed into a new company, known as Racal Instruments, Ltd., which will give it far greater scope for production and development. Mr. J. H. Head, late of Advance Components, Ltd., has joined the board of this new company as director and general manager.

Birth Notices

Anderson.—On Feb. 23, to Flt. Lt. and Mrs. D. J. Anderson—a son.

Brooks.—On Feb. 21, at the Louise Margaret Hospital, Aldershot, to Jean (*née* Thompson), wife of Flt. Lt. D. G. Brooks—a daughter.

Edwards.—On March 1, at the Radcliffe Infirmary, Oxford, to Rosemary (*née* Kerrigan), wife of Flt. Lt. D. J. Edwards—a daughter.

Elder.—On March 2, at R.A.F. Hospital, Halton, to "Biddy," wife of Flt. Lt. W. J. Elder—a daughter.

Hemsley.—On Feb. 28, to Kathleen, wife of Flt. Lt. T. Hemsley, R.A.F. Tangmere—a daughter.

Howlett.—On Feb. 26, at Highfield Maternity Home, Barnstaple, to Sylvia (*née* Foster), wife of Sqn. Ldr. N. S. Howlett—a daughter.

Jarvis.—On Feb. 20, to Patricia (*née* Hastings), wife of Flg. Off. P. D. Jarvis, R.A.F. Jever—a daughter.

Rolfe.—On Feb. 28, at Brook Street Maternity Home, Ipswich, to Pamela (*née* Moore), widow of Flt. Lt. J. I. T. Rolfe—a daughter.

Trent.—On Feb. 23, at R.A.F. Hospital, Ely, to Doreen (*née* Sargeant), wife of Flt. Lt. P. Trent—a daughter.

Aviation Calendar

March 16.—R.Ae.S. Derby Branch lecture, "The British Aircraft Industry," by E. C. Bowyer, at the Rolls-Royce Welfare Hall, Nightingale Road, **Derby,** at 18.15 hrs.

March 18.—Aircraft Recognition Society, film show, in the R.Ae.S. Library, 4 Hamilton Place, **London,** W.1, at 19.00 hrs.

March 18.—Kronfeld Club talk, "Instrumentation and Cloud Flying," by David Ince, at 74 Eccleston Square, **London,** S.W.1.

March 18.—R.Ae.S. Christchurch Branch lecture, "Materials for Supersonic Aircraft," by G. Meikle, at the King's Arms, **Christchurch,** at 19.30 hrs.

March 18.—R.Ae.S. Coventry Branch lecture, "Servicing of Civil Aircraft," by I. J. Gregory, at the Wine Lodge, Corporation Street, **Coventry,** at 19.30 hrs.

March 19.—R.Ae.S. Isle of Wight Branch lecture, "The Trials and Tribulations of Airline Operation," by Capt. J. N. M. Weir, at the Saunders-Roe Sports and Social Club, **East Cowes,** at 18.00 hrs.

March 19.—R.Ae.S. Guided Flight Section lecture, "Long-range Missiles," by E. C. Cornford, at the Inst. of Civil Engineers, Great George Street, **London,** S.W.1, at 18.00 hrs.

March 19.—Inst. of Production Engineers, Southern Region lecture, "British Aircraft Production Methods," by L. G. Burnard, at the Great Western Hotel, **Reading,** at 19.30 hrs.

March 25.—R.Ae.S. Southampton Branch A.G.M. in the Inst. of Education, University of **Southampton,** at 20.00 hrs.

March 25.—R.Ae.S. Preston Branch lecture, "The Application of Area Rule to Aircraft Design," by W. T. Lord (R.A.E., Farnborough), at the Queen's Hotel, **Lytham,** at 19.30 hrs.

March 25.—R.Ae.S. Weybridge Branch lecture (with the Southern Branch of the Inst. of Mech. Engineers), "Guidance and Control of Missiles," by L. H. Bedford (English Electric Co.), at the Apprentice Training School, Vickers-Armstrongs (Aircraft), Ltd., **Weybridge,** at 18.10 hrs.

March 25.—R.Ae.S. Bristol Branch A.G.M. and film show, at Filton House, **Bristol,** at 18.00 hrs.

March 25.—R.Ae.S. Graduates and Students Section lecture, "Aircraft Escape Techniques," by J. Martin (Martin-Baker Aircraft), in the library, 4 Hamilton Place, **London,** W.1, at 19.30 hrs.

March 25.—R.Ae.C. A.G.M. at 119 Piccadilly, **London,** W.1, at 18.00 hrs.

March 25.—Kronfeld Club talk, "Soaring and Cross-country Flying," by A. Goodhart, at 74 Eccleston Square, **London,** S.W.1.

March 26.—R.Ae.S. Southend Branch lecture, "Flying-boats," at the Labour Hall, Boston Avenue, **Southend,** at 19.30 hrs.

March 27-30.—Faster Gliding Rally, organized by Midland Gliding Club, at the **Long Mynd,** Salop.

April 1.—R.Ae.S. Gloucester and Cheltenham Branch, A.G.M. and film show, at the Wheatstone Hotel, **Gloucester,** at 19.30 hrs.

April 1.—R.Ae.S. Brough Branch lecture, "Flying with the Trans-Antarctic Expedition," by Sqn. Ldr. J. H. Lewis, in the lecture Hall, Electricity Offices, Ferensway, **Hull,** at 19.30 hrs.

April 1.—Kronfeld Club talk, "Field Landings and Retrieving," by Lorne Welch, at 74 Eccleston Square, **London,** S.W.1.

New Patents

APPLICATION ACCEPTED

812,167.—Rolls-Royce, Ltd.—"Jet nozzles for jet-propulsion purposes."—April 16, 1957. (April 17, 1956.)

Application open to public inspection April 22, 1959; opposition period expires on July 22, 1959.

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Compiled by the Staff of 'The Aeroplane'

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FROM B.K.S. AIR TRANSPORT, LTD., OF BERK HOUSE, BAKER STREET, LONDON, W.1:—

APPLICATION NO. 528/3 for an amendment to the terms of approval of the Normal Scheduled Service which they are authorized to operate on the route Southend or London Airport-Bordeaux (opt. tech.)-Bilbao and/or Santander at a frequency of two return flights weekly until October 31, 1962, so as to remove the existing condition that services may be operated from London Airport only on the days when the company operate their U.K. Internal Service between Newcastle and London.

APPLICATION NO. 35/5 for an amendment to the terms of approval of the U.K. Internal Service which they are authorized to operate with Ambassador and Dakota aircraft on the route Newcastle and/or Leeds-Bournemouth (Hurn) (opt. tech.)-Guernsey (opt.)-Jersey at a frequency in accordance with traffic demand (terminating Leeds-Jersey sector flights may be operated provided that not more than three such flights are operated on each Friday, Saturday and Sunday during the period mid-May to end September), so as to extend the period of approval for 10 years to April 30, 1970, and to enable the company to operate later also with Viscount and Vanguard aircraft.

FROM SILVER CITY AIRWAYS, LTD., OF 62 BROMPTON ROAD, LONDON, S.W.3:—

APPLICATION NO. 11/4 for an amendment to the terms of approval of the Normal Scheduled Service which they are authorized to operate with Dakota, D.H.89(a), Dove, Heron and Bristol 170 aircraft between Lydd and Le Touquet at a frequency of up to 12 return flights daily until March 31, 1960, and which they have previously applied to operate on the route Lydd or Manston-Le Touquet, so as now to enable them to operate also with Hermes aircraft.

APPLICATION NO. 29/4 for an amendment to the terms of approval of the seasonal Normal Scheduled Service which they are authorized to operate with Dakota, D.H.89(a), Dove, Heron and Bristol 170 aircraft on the route Lydd-Ramsgate (opt.)-Ostend at a frequency of from six to 21 return flights weekly during April and May each year and up to 50 return flights weekly from June to September each year until March 31, 1960, and which they have previously applied to operate on the route Lydd or Manston-Ramsgate (opt.)-Ostend, so as now to enable them to operate also with Hermes aircraft.

FROM MORTON AIR SERVICES, LTD., OF CROYDON AIRPORT, CROYDON, SURREY:—

APPLICATION NO. 123/1 for an amendment to the terms of approval of the seasonal Normal Scheduled Service which they are authorized to operate with Dove and Heron aircraft between London (Croydon) and Le Touquet from April 1 to October 31 each year, at a frequency of up to 92 return flights weekly until October 31, 1959, so as to extend the period of approval for 10 years to October 31, 1969, and to enable the company to operate on the amended route London (Croydon or Gatwick)-Le Touquet.

APPLICATION NO. 12/5 for an amendment to the terms of approval of the seasonal U.K. Internal Service which they are authorized to operate with Dove and Heron aircraft on the route London (Croydon)-Guernsey or Jersey at a frequency of up to four return flights each Saturday, two return flights each Friday and two return flights each Sunday from mid-June to mid-September, 1959, so as to extend the period of approval for 10 years to September 30, 1969, and to enable the company to operate on the amended route London (Croydon or Gatwick)-Guernsey or Jersey from June 1 to September 30 each year.

FROM OLLEY AIR SERVICE, LTD., OF CROYDON AIRPORT, CROYDON, SURREY:—

APPLICATION NO. 54/3 for an amendment to the terms of approval of the seasonal U.K. Internal Service which they are authorized to operate with Dove aircraft between London (Croydon) and Jersey at a frequency of four return flights each Saturday, two return flights each Friday and two return flights each Sunday and between London (Croydon) and Guernsey at a frequency of three return flights each Saturday, two return flights each Friday and one return flight each Sunday from mid-June to mid-September, 1959, so as to extend the period of approval for 10 years to September 30, 1969, and to enable the company to operate on the amended routes London (Croydon or Gatwick)-Jersey and London (Croydon or Gatwick)-Guernsey from June 1 to September 30 each year.

These applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. 480-1

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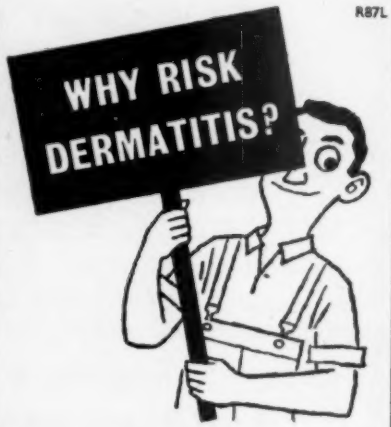

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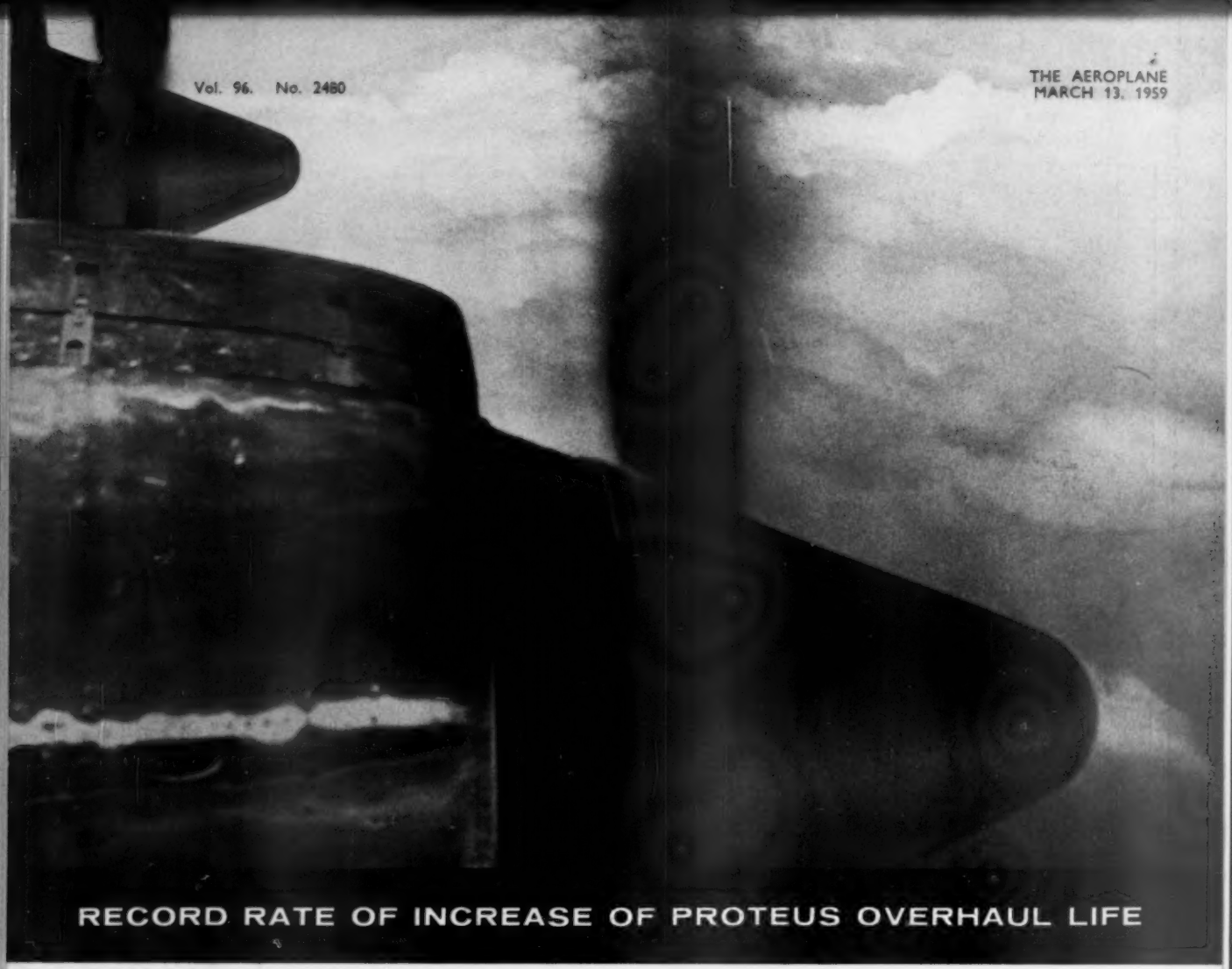

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